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# EARTHQUAKE AND FIRE ACT AUTHORIZATION

## HEARINGS

BEFORE THE

SUBCOMMITTEE ON
SCIENCE, RESEARCH AND TECHNOLOGY

OF THE

COMMITTEE ON
SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

NINETY-SIXTH CONGRESS

SECOND SESSION

FEBRUARY 26, 27, AND 28, 1980

[No. 140]

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Science and Technology

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# EARTHQUAKE AND FIRE ACT AUTHORIZATION

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TUESDAY, FEBRUARY 26, 1980

House of Representatives,
Committee on Science and Technology,
Subcommittee on Science, Research and Technology,
*Washington, D.C.*

The subcommittee met, pursuant to notice, at 10:15 a.m., in room 2325 Rayburn House Office Building, Hon. George E. Brown (chairman of the subcommittee) presiding.

Present: Messrs. Brown, Hollenbeck, Watkins, and Ritter.

Mr. Brown. The subcommittee will come to order.

Today we begin 3 days of hearings, which, I might add, should not lead you to believe that is just the ordinary 6 hours. That is 15 hours of hearings on budget authorizations pursuant to the Fire Prevention Control and Earthquake Hazard Reduction Acts.

The administration has recently placed the primary responsibility for coordinating the Federal programs mandated by these acts in a newly created agency; the Federal Emergency Management Agency—FEMA. This is an opportune time for these hearings because the subcommittee has the opportunity to explore, at the ground floor level, the plans FEMA has developed to carry out its responsibilities under these two acts.

The subcommittee is particularly interested in determining how FEMA has organized itself to meet its responsibilities. It is also most interested in exploring the manner in which FEMA intends to coordinate and give direction to the activities of the other Federal agencies which participate in the earthquake hazard reduction and fire prevention control programs.

Federal Emergency Management Agency programs are not only important, they are urgently needed. Given the recent flooding and yesterday's earthquake in southern California, we need only to look to recent events to support this sense of urgency. During the course of these hearings, we hope to learn how well FEMA is prepared to respond to similar emergencies throughout the country.

But responding to emergencies, such as earthquake and fire-related emergencies, is not enough. We need new knowledge that will enable us to better deal with earthquake and fire hazards and we need to translate this knowledge into workable plans that will mitigate the effects of these hazards and, in some cases, prevent them from happening. Thus, substantial research and planning activities are essential to the effectiveness of the earthquake and fire programs. An important part of these hearings, therefore, will be an examination of the progress of these research and planning programs.

Lastly, the subcommittee is interested in learning how FEMA is putting the information it generates and the plans it develops into action. In particular, the subcommittee is interested in determining how FEMA interacts with State and local governments in its efforts to disseminate information and to implement its plans.

We have a very able group of witnesses both this morning and for the remainder of the week to aid us in our exploration, and we expect a very productive set of hearings.

Mr. Hollenbeck, would you care to make a statement?

Mr. HOLLENBECK. Yes, Mr. Chairman. At this time I will not make a formal statement. I will have some formal remarks to make at Thursday's hearing, and we can insert them in the record at that place.

I would, however, like to express two concerns that I have right now. One, Mr. Chairman, is with the current lack of funding for the arson program, which has been of great concern to this subcommittee, and the other, Mr. Macy, is with your office, and your lack of response to my office when I telephoned you concerning the matters of last week. I think that we have seen over the last couple of years, a lack of immediate responsiveness of your office to the subcommittee and to my office that greatly concerns me. Thank you, Mr. Chairman.

Mr. BROWN. You are going to let that stand. You don't want to pursue it further.

Mr. HOLLENBECK. We will pursue it. I would hope we could pursue that further, Mr. Macy, without putting it on the record.

Mr. MACY. I would hope so, Mr. Hollenbeck. I regret very much that is your assessment of our service.

Mr. HOLLENBECK. That is in no way an assessment of the service of your Agency. It is a matter of your Agency's responsiveness to the congressional branch.

Mr. BROWN. Our first witness this morning is John W. Macy, the head of the Federal Emergency Management Agency, and I think it is safe to say, without contradiction, one of the most distinguished civil servants in the Federal Establishment.

I would like at this point to introduce his brief biographical sketch in the record, but I would just like to say for the record that Mr. Macy's career in the Federal Government goes back 40 years. It is a long time, isn't it?

Mr. MACY. Yes, sir.

Mr. BROWN. It is truly an outstanding record, and he has been recognized for the splendid service he has rendered. I am sure with regard to the problems Mr. Hollenbeck has been having, this is an aberration that will be readily corrected in the future.

Mr. HOLLENBECK. I am aware of Mr. Macy's record as well, and I would hope that that is the case. This has been a very trying budgetary season for all of us, and we have had a few problems that do not in any way reflect upon your competence.

Mr. MACY. I look forward to discussing with you the conditions that led to your conclusion as early as possible.

Mr. HOLLENBECK. Yes, hopefully today.

Mr. MACY. In an effort to rectify whatever has developed.

Mr. BROWN. Mr. Macy, obviously we have asked you to testify first because of your leadership role, and I think you can set the stage for the additional hearings that will come along. Exercising the proper oversight and the proper authorization policy with regard to your agency is going to present some difficulties to us in the Congress because some of the programs, as we have mentioned, cut across many agency lines. This committee does not have full jurisdiction over the full range of your activities, as you know. However, we are in a position where we in some cases will have jurisdiction over the other agencies with which you will be cooperating, but with regard to your major activities we do not have jurisdiction, and we are seeking to enter into close cooperation with the personnel of the Armed Services Committee so that in areas of common concern we may approach the problems with a degree of cooperation and hopefully in that way we will avoid creating more problems than we solve, which is the procedure of the process.

So, recognizing that, I hope that you will give us an insight as you go along into how we can most effectively handle our parts of the responsibilities in that regard.

At this point I welcome you to present your statement. You may either read it or brief it, as you see fit. The full text will appear in the record and you may proceed, Mr. Macy.

[The biographical sketch of John Macy follows:]

### JOHN W. MACY, JR.

John W. Macy, Jr., Director of the Federal Emergency Management Agency (FEMA).

Under the President's Reorganization Plan No. 3, approved by Congress, FEMA consolidated in one agency closely allied Federal programs involved with preparedness, mitigation, and response to national emergencies ranging from natural and manmade disasters to nuclear attack.

Mr. Macy joined the Federal government in 1939 as an Administrative Assistant in the Social Security Board. He held increasingly important positions with the War Department, Atomic Energy Commission and the Department of the Army and was Executive Director of the Civil Service Commission, 1953–58.

From 1961 to 1969, Mr. Macy was Chairman of the Civil Service Commission and Special Assistant to the President with responsibility for search and evaluation of candidates for Presidential appointment. He was awarded the Presidential Medal of Freedom.

He served as President of the Corporation for Public Broadcasting, President of the Council of Better Business Bureaus, Public Member of the Board of Governors of the American Stock Exchange, and president of a management consulting firm.

His international service includes chairmanship of the U.S. Delegation of the International Institute of Administrative Sciences, special consultant to the U.S. Agency for International Development, and appointment by the United Nations Secretary-General to membership on the International Civil Service Advisory Board.

Mr. Macy has an extensive background in education, having served as a consultant, instructor, lecturer, and governing board member of several colleges and universities in the United States. From 1958 to 1961, he served as Executive Vice President of his alma mater, Wesleyan University in Middletown, Connecticut.

He was graduated with honors and distinction with a bachelor of arts degree from Wesleyan University, and performed graduate study in public administration at the American University and government internship in Washington in the National Institute of Public Affairs. He has been awarded honorary doctor of law degrees from 11 universities.

Mr. Macy was born April 6, 1917, in Chicago, Illinois, and resides in McLean, Virginia.

## STATEMENT OF JOHN W. MACY, JR., DIRECTOR, FEDERAL EMERGENCY MANAGEMENT AGENCY

Mr. MACY. Thank you very much, Mr. Chairman.

In response to your particular point concerning the jurisdiction over programs now the responsibility of the Federal Emergency Management Agency, I endorse what you say because it is very clear that there are several committees and subcommittees that have portions of jurisdiction.

In view of the broad scope of the reorganization that has assigned five different agencies to become elements of this new agency, and although there will be consolidation of review in the appropriations process, the authorizing responsibility will be divided among several committees, as you have indicated, and it is the purpose of the Agency to be as responsive and accountable as possible to every one of those committees.

It is a pleasure to appear before you and Mr. Hollenbeck in support of the National Earthquake Hazards Reduction Act. Before I discuss specific programs in FEMA, I would like to briefly recount for you the functions and missions of the Agency. FEMA plays a major role in every aspect of the Nation's comprehensive approach to the management of emergencies, be they natural or man-caused, civil or military. We provide the focal point at the Federal level for the identification of probable dangers and emergencies, the formulation of plans and programs to manage Federal response to disasters, Federal recovery services and assistance, and crisis management. A new function not previously a part of the predecessor agencies is a firm commitment to incorporation of hazards mitigation as an integral part of our programs.

Our earthquake hazards reduction activities are conducted under the leadership of the Office of Mitigation and Research. This Office is the focus for our research and development activities and for the development of innovative programs and approaches in emergency management. Activities in this program are directed at increasing the capabilities of the United States to predict, prevent, and respond to emergencies and disasters, and to recover from their impact. The objective of this problem-focused program is to improve scientific and engineering knowledge in reducing and mitigating the life loss, injury, danger, and economic and social disruption from such occurrences. Activities are, or will be, directed at a broad spectrum of disasters, emergencies, and hazards. The earthquake hazards reduction activities of the Agency are intended to be prototypical of the approach to be utilized in moderating the impact of other natural and manmade hazard occurrences.

I would like to turn now to a detailed discussion of FEMA's Presidentially assigned responsibilities under the National Earthquake Hazards Reduction Act. I will first make some observations on the general status of the national earthquake hazards reduction program from our position as lead agency in this effort. I will then discuss specific activities and planned initiatives within FEMA as they relate to accomplishing the objectives of the Earthquake Hazards Reduction Act.

In accordance with the Earthquake Hazards Reduction Act of 1977, Public Law 95-124, the President has asssigned FEMA the following

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responsibilities, among others: Overall coordination of Federal department and agency programs in research and application, leadership and support to the Federal Interagency Committee on Seismic Safety in Construction as it develops seismic design and construction standards for Federal projects; examination of the appropriate role of insurance in mitigating the impacts of earthquakes; and response plans and assistance to State and local governments in the preparation of their plans.

Before discussing our specific assignments under the national program, it is useful to review the purposes, objectives and implementation of the act. We believe that the act has withstood the test of the past 3 years. The purpose and objectives established within the act are viewed by us to be as complete and appropriate now as when the act was passed. The act specifically required the President to develop an implementation plan which set forth year by year targets through at least 1980, specifying the role of Federal agencies and recommending appropriate roles for State and local units of goverment, individuals, and private organizations. The President submitted to the Congress on June 22, 1978, the national earthquake hazards reduction program, which outlined specific actions and assignments. On June 19, 1978, as part of his Reorganization Plan No. 3 of 1978, the President specified that the then proposed Federal Emergency Management Agency would exercise responsibility under the act and under the President's program as lead agency. During the period between this assignment and the Executive order establishing this authority in FEMA on July 27, 1979, the Office of Science and Technology Policy discharged the responsibility of interim lead agency.

While progress has not proceeded as rapidly as some of the architects of the program would have liked, substantial results have been achieved. I hope to show today that we have accomplishments and programs that can advance this effort quickly from here on out. In the past 2½ years substantial progress has been made in a number of areas pertaining to earthquake hazards reduction. I would like now to review the activities undertaken and progress made in each of the six objective areas established in section 5(c) of the Earthquake Hazards Reduction Act:

(1) Earthquake resistant construction: As noted in the report on the national earthquake hazards reduction program submitted to the Congress in September 1979, the Federal Interagency Committee on Seismic Safety in Construction has been established, and has participation from over 130 individuals from 17 Federal agencies and departments. FEMA chairs this committee. The committee has three principal objectives:

Develop seismic design and construction standards for Federal projects; develop guidelines to insure serviceability following an earthquake of vital facilities constructed or financed by the Federal Government; and, develop guidelines that provide for independent and State and local review of seismic considerations in the construction of critical facilities built and financed by the Federal Government, where appropriate.

The activities of the Committee relating to the development of seismic design and construction standards for Federal building projects are proceeding well. We currently expect a draft document to be circulated among the committee members in May. This is a major assignment to the Federal agencies and represents a substantial potential to change building practices of Federal agencies once these provisions have been subjected to review and test application. In addition, the Interagency Committee is developing standards and techniques for identifying existing hazardous buildings, the design, construction and retrofit of energy, water, telecommunication systems, developing standards for design and construction guidelines to insure survivability of vital community facilities and developing guidelines for the safety evaluation of federally owned critical facilities. These other activities are proceeding slowly.

A key element in the achievement of increased public (that is non-Federal) earthquake safety is the continued development, evaluation and improvement of model seismic design provisions suitable for incorporation into local building codes and practices. An historically major impediment to achieving this objective has been that the diverse elements of the building community (professional societies, and labor, trade, model code, voluntary standards, public interest and public agency organizations) have not had a forum in which to develop such standards. This has been remedied through the formation, in April 1979, of the Building Seismic Safety Council (BSSC) as an independent, voluntary body to enhance the public's safety by fostering improved seismic safety provisions suitable for use throughout the United States.

The first specific task undertaken by the council is to review extensively the tentative provisions for the development of seismic regulations for buildings, prepared by the Applied Technology Council under contract to the National Bureau of Standards with the National Science Foundation's support. After completion of this review, modification of the provisions, and test by trial designs, the member organizations will be encouraged to adopt the resultant provisions. It is important to note that the council has not been formed to replace the initiatives of its member organizations, but is to provide a national forum where its members can develop seismic design provisions that are responsive to the public's interest. This is a unqiue undertaking in the building community. The opportunity for different groups (public officials, owners, architects) to consider the merits of proposed provisions before they are incorporated into a code or national standard (without the usual heated, adversary climate) should substantially improve the process of reaching consensus views which provide appropriate and effective public earthquake building regulations.

The Veterans' Administration program for assessing the seismic vulnerability of its hospitals, and its major effort to rehabilitate hazardous structures is the notably successful Federal construction program actually reducing earthquake risks. They have not only replaced and repaired facilities in the widely recognized hazardous area of the West, but also undertook substantial investment in the East, most notably their Charleston, S.C., facility.

2. Earthquake Prediction: Earthquake prediction is still in the realm of a research effort. The basic research of the National Science Foundation and basic and applied research activity of the Geological Survey are progressing well. No predictions have yet been made from this scientific effort which have required public action. The USGS has

established an Earthquake Prediction Evaluation Council. This Council is charged with evaluating the scientific evidence supporting the prediction presented to it for review. The committee held its first meeting on February 4 and 5 of this year. This committee complements the California Earthquake Prediction Evaluation Council established approximately 5 years ago to advise the Governor of the State of California. There is growing interest particularly in California in the possibility that major earthquakes may be predicted. This was particularly evident at the recent Earthquake Prediction Information Conference held on January 27–30 in Los Angeles under the joint sponsorship of the USGS, FEMA, the California Seismic Safety Commission, California Office of Emergency Services, the California Department of Mines and Geology, and the city of Los Angeles. We in FEMA believe that the near-term prospects for prediction are now sufficient to warrant initiation of planning activities on Federal, State, and local responses to potential earthquake predictions. We will discuss this later in the testimony.

3. Model Codes: The publication of the "Applied Technology Council's Tentative Provisions for the Development of Seismic Regulations for Buildings," which I referred to earlier, represents a major step toward improving building codes and standards for use throughout the United States.

The provisions represent the result of a concerted effort by a multidisciplinary team of nationally recognized experts in earthquake engineering, design professionals. researchers, Federal agency representatives, staffs from the model code organizations and representatives from State and local governments throughout the United States. The provisions are comprehensive in nature and deal with earthquake resistant design of the structural system, architectural and nonstructural elements and mechanical-electrical systems in buildings. Both new and existing buildings are included. The provisions embody several new concepts which are significant departures from existing seismic design provisions. An extensive commentray documenting the basis for the provisions is included. We feel that these provisions for building design and regulation are a major step toward giving the public the array of design aids useful to public and private earthquake safety decisions. After careful review by the BSSC, which I mentioned earlier, we expect these provisions or a derivative thereof, to be widely used by the design and regulatory professions.

4. Planning and Reconstruction: The States of California and Utah and to a lesser extent the State of Nevada have vigorous State seismic safety organizations. In California, the State has developed an earthquake hazards reduction implementation plan which parallels and complements that prepared at the Federal level. The Western States have formed a Western States Seismic Policy Conference as a vehicle to discuss common issues. They will hold their second annual meeting this April.

Earthquake loss estimates studies for San Francisco, Los Angeles, Salt Lake City, and the Puget Sound areas had been completed prior to the passage of the Earthquake Hazards Reduction Act. Since the passage of the act, such studies have been initiated by FEMA in Alaska and Hawaii and are planned for South Carolina, Massachusetts, the Mississippi Valley, and upper New York areas. A comprehensive

Federal response plan is now complete for the San Francisco Bay area (although this plan does not include the possibility of earthquake prediction). Such plans will be completed in each of the areas for which loss studies have been completed.

The role of insurance as a means to compensate and encourage earthquake mitigation is potentially great. While residential and commercial earthquake insurance is currently available, it is not widely purchased. There are serious questions about the capability of the insurance industry alone to absorb the costs of a catastrophic earthquake if such insurance were widely purchased. FEMA, drawing upon its expertise and experience in the administration of the national flood insurance program, is now undertaking a study of the appropriate role of insurance as an earthquake mitigation strategy and an examination of the role of the Federal Government, if any, in this important area.

The Disaster Relief Act of 1974, Public Law 93–288, specified that the President may establish mitigation standards for a community hit by a disaster to follow in its reconstruction efforts, so as to reduce the probability of a repetition of the event. A FEMA contractor is now developing guidelines and procedures to implement this section of the act for earthquakes.

5. Public Education: The National Science Foundation and the Geological Survey have conducted many seminars and training functions directed prinicpally at the design profession community. Efforts, to date, for general education have been very limited and at the initiative of State and local communities FEMA is currently investigating the incorporation of earthquake-related issues into its public education programs.

6. Research: A sound basis has not been established in the engineering, geologic, and seismologic sciences on which a more aggressive applied and developmental research program could be based. Currently basic research programs in each of the physical sciences and engineering are, in our judgment, funded at the proper level. Applied research support tends to be lagging behind the opportunities presented, and development-related activities are underfunded. This latter area represents a substantial opportunity for improvement of the overall national science and technology development program.

In the areas of social, economic, administrative, and political sciences research there is a minimal effort currently underway among the Federal agencies. The current research program may be inadequate to meet the objectives of the act.

7. Earthquake control or modification: Research efforts in this area are limited, appropriately so in our judgment. The extensive efforts on earthquake mechanisms pursued for basic seismology purposes and in support of the earthquake prediction program will provide the necessary basis for future efforts in the areas of modification or control.

FEMA earthquake hazards reduction. We have accomplished much in the past 3 years, but there remains much to be done, Mr. Chairman. The national program has been characterized, to date, by relatively large research expenditures and relatively inexpensive coordination, planning and staff work for application. We are now at a point where the opportunities for application are growing and can be expected to accelerate in the next few years. Clearly, the principal imperative before Federal, State, local, voluntary, and private organizations is to more effectively and efficiently apply that which we know and that which we will learn from research in the next few years. Responsibilities to lead this overall effort from a Federal point of view resides in FEMA. This will not be an easy undertaking. As noted in the act, portions of 37 to 39 States are subject to major or moderate earthquake risks. Yet even California, the widely considered most vulnerable State, is viewed as having shortcomings in its earthquake hazards reduction programs. This is highlighted by the general findings of the California Assembly Subcommittee on Emergency Planning and Disaster Relief, when it stated:

> California, as a State, is ill-prepared to respond to a major disaster (such as a major earthquake) striking a metropolitan area, and as a result, could incur unacceptably high levels of casualties and damage should a disaster strike. The subcommittee finds that the level of emergency preparedness in California is alarmingly low when considering the probability of such a disaster striking a heavily populated area.

Thus, while California has paid considerable attention to some aspects of building codes and standards, it is not in the judgment of the legislature, adequately prepared for a major earthquake. This poses a clear challenge to the private sector, local government, State, and the Federal Government to meet.

During this coming year, Mr. Chairman, FEMA will continue to coordinate Federal earthquake hazards reduction programs, provide leadership for the Interagency Committee on Seismic Safety in Construction, support Federal participation in the Building Seismic Safety Council, accelerate the conduct of earthquake loss studies and preparation of Federal response plans, and complete analyses of the role of insurance and financial institutions in mitigation.

Emergency temporary housing in time of disaster is one of the most explosive problems to which the Government must respond. I need not remind those of you who have had a major disaster in your district of the importance to the public of providing timely access to housing. To date, the largest demand for emergency housing has been approximately 27,000 units. Should a large earthquake strike southern California, it would not be unreasonable to expect demands for over 50,000 units. FEMA has undertaken a southern California disaster housing response study to examine the needs for strategies to provide adequate long-term lodging to individuals and families—including the congregate or mass accommodations which are usually provided by the American National Red Cross during the first few days immediately following a disaster. This housing study is a component of a larger planning effort designed to increase the capability of Federal, State, and local officials to provide assistance to victims during large-magnitude earthquakes and other peacetime emergencies.

The study entails:

1. Selection of a maxium credible earthquake that could occur in the San Andreas Fault—an 8.3 Richter event.
2. Determination of the damage patterns by geographic zones that might result from ground shaking as well as from secondary effects, such as liquefication, landslides, dam failures, utility outages, and fires.

3. Inventory of dwelling units by structural categories—utilizing Census Bureau data and/or tax assessment data for the seven-county planning area and determination of damage functions for each category of buildings.

4. Estimate of the number of housing units made uninhabitable in each category and in each zone.

5. An estimate of the number of families made homeless by the event in each zone.

6. A preparedness plan for providing rehousing assistance to all families made homeless by the event.

We expect this study to be completed by the end of the summer. Early indications are that perhaps as many as 60,000 families can be expected to be homeless, with 12,000 in San Bernadino County, 2,500 in Ventura County, and 34,000 in Los Angeles County. This study has been very successful to date, due in particular, to the way in which city, county and State officials, and Red Cross staff have willingly made major contributions to the study.

## PLANNING FOR EARTHQUAKE PREDICTION RESPONSE

The decade ahead promises to be one of significant advances in the science of earthquake prediction. There is a widespread expectation that earthquake predictions will somehow bring about significant reductions in deaths and injuries, and partial predictions in the property losses that would otherwise occur during unpredicted earthquakes. The promise is there, but the systems and procedures for meeting that promise are not yet in place.

FEMA is planning a cooperative study with State and local governments and the private sector to develop an effective program to respond to credible earthquake predictions.

There are several major areas of concern to be addressed in prediction planning. Each of these would contain components of ongoing—nonprediction—programs, but with special features and adaptations especially suited to the postprediction interval:

Public safety, reduction of property damage, continuity of life lines, self-sufficiency of families and neighborhoods in the immediate aftermath of the earthquake; emergency response and disaster recovery, economic impact.

A number of related activities will need to be in place so that prediction response plans can provide timely and effective actions. The related activities include:

Coordinated prediction evaluation and dissemination procedures; identification of earthquake hazards; seismic codes and mitigation programs; a consensus among earthquake professionals and public officials regarding productive postprediction response needs; public education resources geared to prediction response needs; viable emergency response plans; and mechanisms for disaster recovery planning.

We look forward to a useful and productive alliance with State and local governments in preparing a prototypical earthquake prediction program. While initially we intend to undertake this using southern California as a test region, we expect that the procedural tools and techniques developed will be readily applicable in other large metropolitan areas in which earthquake predictions are likely. This is a very exciting program in which I have taken a great deal of personal interest, Mr. Chairman.

In conclusion, we believe that much has been accomplished under the earthquake hazards reduction program. As is true of most substantial undertakings, much remains yet to be accomplished. We hope that as you view the Federal program's accomplishments of the last few years, that you will not only focus on that which has yet to be done, but realize the tremendous distance we have covered during this time. We are now at a pivotal point where the public safety can be materially improved with more public education, more effective joint planning, and improved professional practices.

I hope that this assessment of Federal earthquake hazards reduction activities is useful to the committee in its consideration of reauthorization of the Earthquake Hazards Reduction Act. We support reauthorization of this act and look forward to working with other Federal agencies and this committee in further development of a sound earthquake hazards reduction program.

Mr. Chairman, I have emphasized the earthquake program in this testimony. However, I want to assure the committee that we have an equally strong commitment to national security research as well as other research efforts directed at the total range of natural and technological hazards facing the country.

Mr. Richard Green, Associate Director of the Office of Mitigation and Research, was to have accompanied me here this morning. Unfortunately, Mr. Green is the victim of a virus which research and development has not obliterated from the scene up until this time, and he is unable to be with me.

I do have, however, Dr. Charles Thiel, who is the Deputy Associate Director of Mitigation and Research, and who, I should add, is the project manager for the earthquake hazards efforts within the Agency, and in my view is one of the outstanding professionals in the field of earthquake endeavors. He and I will now be happy to answer any questions you have on the specific activities in our earthquake hazards reduction program.

I appreciate your patience and courtesy in permitting me to present this particular report. This is the first effort to give an accountability in this program since it was assigned to FEMA, and I believe that it was important that it be as comprehensive as the time permits here this morning.

[The prepared statement of Mr. Macy follows:]

## STATEMENT OF JOHN W. MACY, JR.

Mr. Chairman it is a pleasure to have the opportunity to appear again before the Subcommittee on Science and Technology and to discuss FEMA's activities in support of the National Earthquake Hazards Reduction Act. Before I discuss specific programs in FEMA I would like to briefly recount for you the functions and missions of the agency. FEMA plays a major role in every aspect of the Nation's comprehensive approach to the management of emergencies, be they natural or man-caused, civil or military. We provide the focal point at the Federal level for: The identification of probable dangers and emergencies; the formulation of plans and programs to manage Federal response to disasters; Federal recovery services and assistance; and crisis management.

A new function not previously a part of the building block agencies is a firm commitment to incorporation of hazards mitigation as an integral part of our programs.

Our earthquake hazards reduction activities are conducted under the leadership of the Office of Mitigation and Research. This office is the focus for our research and development activities and for the development of innovative programs and approaches in emergency management. Activities in this program are directed at increasing the capabilities of the United States to predict, prevent, and respond to emergencies and disasters, and to recover from their impact. The objective of this problem focussed program is to improve scientific and engineering knowledge in reducing and mitigating the life loss, injury, danger, and economic and social disruption from such occurrences. Activities are, or will be, directed at a broad spectrum of disasters, emergencies, and hazards. The earthquake hazards reduction activities of the agency are intended to be prototypical of the approach to be utilized in moderating the impact of other natural and manmade hazard occurrences.

## EARTHQUAKE HAZARDS REDUCTION

I would like to turn now to a detailed discussion of FEMA's presidentially assigned responsibilities under the National Earthquake Hazards Reduction Act. I will first make some observations on the general status of the national earthquake hazards reduction program from our position as lead agency in this effort. I will then discuss specific activities and planned initiatives within FEMA as they relate to accomplishing the objectives of the Earthquake Hazards Reduction Act.

In accordance with the Earthquake Hazards Reduction Act of 1977, Public Law 95-124, the president has assigned FEMA the following responsibilities, among others: Overall coordination of Federal department and agency programs in research and application; leadership and support to the Federal Interagency Committee on Seismic Safety in construction as it develops seismic design and construction standards for Federal projects; examination of the appropriate role of insurance in mitigating the impacts of earthquakes; response plans and assistance to State and local governments in the preparation of their plans.

Before discussing our specific assignments under the national program, it is useful to review the purposes, objectives, and implementation of the act. We believe that the act has withstood the test of the past 3 years. The purpose and objectives established within the act are viewed by us to be as complete and appropriate now as when the act was passed. The act specifically required the President to develop an implementation plan which set forth year by year targets through at least 1980, specifying the role of Federal agencies and recommending appropriate roles for State and local units of government, individuals, and private organizations. The President submitted to the Congress on June 22, 1978, the national earthquake hazards reduction program which outlined specific actions and assignments. On June 19, 1978, as part of his reorganization plan number 3 of 1978, the President specified that the then proposed Federal Emergency Management Agency would exercise responsibility under the act and under the President's program as lead agency. During the period between this assignment and the executive order establishing this authority in FEMA on June 27, 1979, the Office of Science and Technology Policy discharged the responsibility of interim lead agency.

While progress has not proceeded as well as some of the architects of the program would have liked, substantial results have been achieved, and I hope to show today that we have accomplishments and programs that can advance this effort quickly from here on out. In the past 2½ years substantial progress has been made in a number of areas pertaining to earthquake hazards reduction. I would like now to review the activities undertaken and progress made in each of the six objective areas established in section 5(c) of the Earthquake Hazards Reduction Act.

(1) *Earthquake resistant construction.*—As noted in the report on the national earthquake hazards reduction program submitted to the Congress in September 1979, the Federal Interagency Committee on Seismic Safety in Construction has been established, and has participation from over 130 individuals from 17 Federal Agencies and Departments. FEMA chairs this committee. The Committee has three principal objectives:

Develop seismic design and construction standards for Federal projects;

Develop guidelines to ensure serviceability following an earthquake of vital facilities constructed or financed by the Federal Government: and,

Develop guidelines that provide for independent and State and local review of seismic considerations in the construction of critical facilities constructed and financed by the Federal Government, where appropriate.

The activities of the subcommittee relating to the development of seismic design and construction standards for Federal building projects are proceeding well. We currently expect a draft document to be circulated among the committee members in May. This is a major assignment to the Federal agencies and represents a substantial potential to change building practices of Federal Agencies once these provisions have been subjected to review and test application. In addition, the interagency committee is developing standards and techniques for identifying existing hazardous buildings, the design, construction and retrofit of energy, water, telecommunication systems, developing standards for design and contruction guidelines to ensure survivability of vital community facilities and developing guidelines for the safety evaluation of federally owned critical facilities. These other activities are proceeding slowly.

A key element in the achievement of increased public (that is non-Federal) earthquake safety is the continued development, evaluation and improvement of model seismic design provisions suitable for incorporation into local building codes and practices. An historically major impediment to achieving this objective has been that the diverse elements of the building community (professional societies, and labor, trade, model code, voluntary standards, public interest and public agency organizations) have not had a forum to develop such standards. This has been remedied through the formation, in April 1979, of the Building Seismic Safety Council (BSSC) as an independent, voluntary body to enhance the public's safety by fostering improved seismic safety provisions. The council was formed through the efforts of organizations representing all segments of the building industry, and with the participation of this agency. The council's objective is to promote the development of seismic safety provisions suitable for use throughout the United States.

The first specific task undertaken by the council is to review extensively the tentative provisions for the development of seismic regulations for buildings, prepared by the Applied Technology Council under contract to the National Bureau of Standards with the National Science Foundation's support. After completion of this review, modification of the provisions, and test by trial designs, the member organizations will be encouraged to adopt the resultant provisions. It is important to note that the council has not been formed to replace the initiatives of its member organizations, but is to provide a national forum where its members can develop seismic design provisions that are responsive to the public's interest. This is a unique undertaking in the building community. The opportunity for different groups (e.g., public officials, owners, architects) to consider the merits of proposed provisions before they are incorporated into a code or national standard (without the usual heated, adversary climate) should substantially improve the process of reaching consensus views which provide appropriate and effective public earthquake building regulations.

The Veterans Administration program for assessing the seismic vulnerability of its hospitals, and its major program to rehabilitate hazardous structures is the notably successful Federal construction program actually reducing earthquake risks. They have not only replaced and repaired facilities in the widely recognized hazardous area of the West, but also undertook substantial investments in the East, most notably their Charleston, S.C. facility.

(2) *Earthquake prediction.*—Earthquake prediction is still in the realm of a research effort. The basic research of the National Science Foundation and basic and applied research activity of the geological survey are progressing well. No predictions have yet been made from this scientific effort which have required public action. The USGS has established an Earthquake Prediction Evaluation Council. This Council is charged with evaluating the scientific evidence supporting the prediction presented to it for review. The committee held its first meeting on February 4 and 5 of this year. This committee complements the California Earthquake Prediction Evaluation Council established approximately 5 years ago to advise the Governor of the State of California. There is growing interest particularly in California in the possibility that major earthquakes may be predicted. This was particularly evident at the recent Earthquake Prediction Information Conference held on January 27–30 in Los Angeles under the joint sponsorship of the USGS, FEMA, the California Seismic Safety Commission, California Office of Emergency Services, the California Department of Mines and Geology and the city of Los Angeles. We in FEMA believe that the near term prospects for prediction are now sufficient to warrant initiation of planning activities on Federal, State and local responses to potential earthquake predictions. We will discuss this later in the testimony.

(3) *Model codes.*—The publication of the Applied Technology Council's "Tentative Provisions for the Development of Seismic Regulations for Buildings", which I referred to earlier, represents a major step toward improving building codes and standards for use throughout the United States.

The provisions represent the result of a concerted effort by a multi-disciplinary team of nationally recognized experts in earthquake engineering. Design professionals, researchers, Federal agency representatives, staffs from the model code organizations and representatives from State and local governments throughout the United States were involved. The provisions are comprehensive in nature and deal with earthquake resistant design of the structural system, architectural and nonstructural elements and mechanical-electrical systems in buildings. Both new and existing buildings are included. The provisions embody several new concepts which are significant departures from existing seismic design provisions. An extensive commentary documenting the basis for the provisions is included. We feel that these provisions for building design and regulation are a major step toward giving the public the array of design aids useful to public and private earthquake safety decisions. After careful review by the BSSC, which I mentioned earlier, we expect these provisions or a derivative thereof, to be widely used by the design and regulatory professions.

(4) *Planning and reconstruction.*—The States of California and Utah and to a lesser extent the State of Nevada have vigorous State seismic safety organizations. In California, the State has developed an earthquake hazards reduction implementation plan which parallels and complements that prepared at the Federal level. The Western States have formed a Western States Seismic Policy Conference as a vehicle to discuss common issues. They will hold their second annual meeting this April.

Earthquake loss estimates studies for San Francisco, Los Angeles, Salt Lake City and the Puget Sound areas had been completed prior to the passage of the Earthquake Hazards Reduction Act. Since the passage of the act such studies have been initiated by FEMA in Alaska and Hawaii and are planned for South Carolina, Massachusetts, the Mississippi Valley, and upper New York areas. A comprehensive Federal Response plan is now complete for the San Francisco Bay area, (although this plan does not include the possibility of earthquake prediction). Such plans will be completed in each of the areas for which loss studies have been completed.

The role of insurance as a means to compensate and encourage earthquake mitigation is potentially great. While residential and commercial earthquake insurance is currently available, it is not widely purchased. There are serious questions about the capability of the insurance industry alone to absorb the costs of a catastrophic earthquake if such insurance were widely purchased. FEMA, drawing upon its expertise and experience in the administration of the national flood insurance program, is now undertaking a study of the appropriate role of insurance as an earthquake mitigation strategy and an examination of the role of the Federal Government, if any, in this important area.

The Disaster Relief Act of 1974, Public Law 93-288, specified that the President may establish mitigation standards for a community hit by a disaster to follow in its reconstruction efforts, so as to reduce the probability of a repetition of the event. A FEMA contractor is now developing guidelines and procedures to implement this section of the act for earthquakes.

(5) *Public education.*—The National Science Foundation and the Geological Survey have conducted many seminars and training functions directed principally at the design profession community. Efforts, to date, for general education have been very limited and at the initiative of State and local communities. FEMA is currently investigating the incorporation of earthquake related issues into its public education programs.

(6) *Research.*—A sound basis has now been established in the engineering, Geologic, and seismologic sciences on which a more aggressive applied and developmental research program could be based. Currently basic research programs in each of the physical sciences and engineering are, in our judgment, funded at the proper level. Applied research support tends to be lagging the opportunities presented, and development related activities are underfunded. This latter area represents a substantial opportunity for improvement of the overall national science and technology development program.

In the areas of social, economic, administrative and political sciences research there is a minimal effort currently underway among the Federal agencies. The current research program may be inadequate to meet the objectives of the Act.

(7) *Earthquake control or modification.*—Research efforts in this area are limited, appropriately so in our judgment. The extensive efforts on earthquake mechanisms pursued for basic seismology purposes and in support of the earthquake prediction program will provide the necessary basis for future efforts in the areas of modification or control.

### FEMA EARTHQUAKE HAZARDS REDUCTION

We have accomplished much in the past 3 years, but there remains much to be done. Mr. Chairman the national program has been characterized, to date, by relatively large research expenditures and relatively inexpensive coordination, planning and staff work for application. We are now at a point where the opportunities for application are growing and can be expected to accelerate in the next few years. Clearly, the principal imperative before Federal, State, local, voluntary and private organizations is to more effectively and efficiently apply that which we know and that which we will learn from research in the next few years. Responsibilities to lead this overall effort from a Federal point of view resides in FEMA. This will not be an easy undertaking. As noted in the act portions of 37–39 States are subject to major or moderate earthquake risks. Yet even California, the widely considered most vulnerable State, is viewed as having shortcomings in its earthquake hazards reduction programs. This is highlighted by the general findings of the California Assembly Subcommittee on Emergency Planning and Disaster Relief when it stated.

"California, as a State, is ill-prepared to respond to a major disaster (such as a major earthquake) striking a metropolitan area, and as a result, could incur unacceptably high levels of casualties and damage should a disaster strike. The subcommittee finds that the level of emergency preparedness in California is alarmingly low when considering the probability of such a disaster striking a heavily populated area."

Thus, while California has paid considerable attention to some aspects of building codes and standards, it is not in the judgment of the legislature, adequately prepared for a major earthquake. This poses a clear challenge to the private sector, local government, State and the Federal Government to overcome.

During this coming year, Mr. Chairman, FEMA will continue to coordinate Federal earthquake hazards reduction programs, provide leadership for the Interagency Committee on Seismic Safety in Construction, support Federal participation in the building seismic safety council, accelerate the conduct of earthquake loss studies and preparation of Federal response plans, and complete analyses of the role of insurance and financial institutions in mitigation.

Emergency housing in time of disaster is one of the most explosive problems to which the Government must respond. I need not remind those of you who have had a major disaster in your district of the importance to the public of providing timely access to housing. To date the largest demand for emergency housing has been approximately 27,000 units. Should a large earthquake strike Southern California it would not be unreasonable to expect demands for over 50,000 units. FEMA has undertaken a Southern California disaster housing response study to examine the needs for strategies to provide adequate long-term to individuals and families (including the congregate or mass accommodations which are usually provided by the American National Red Cross during the first few days immediately following a disaster). This housing study is a component of a larger planning effort designed to increase the capability of Federal, State and local officials to provide assistance to victims of large-magnitude earthquakes; during emergencies.

The study entails:

(1) Selection of a maximum credible earthquake that could occur on the San Andreas Fault—an 8.3 Richter event;

(2) Determination of the damage patterns by geographic zones that might result from ground shaking as well as from secondary effects, such as liquefication, landslides, dam failures, utility outages, and fires;

(3) Inventory of dwelling units by structural categories, (utilizing census bureau data and/or tax assessment data for the seven county planning area and determination of damage functions for each category of buildings;

(4) Estimate of the number of housing units made uninhabitable in each category and in each zone;

(5) An estimate of the number of families made homeless by the event in each zone; and

(6) A preparedness plan for providing rehousing assistance to all families made homeless by the event.

We expect this study to be completed by the end of the summer. Early indications are that perhaps as many as 60,000 families can be expected to be homeless with 12,000 in San Bernadino County, 2,500 in Ventura County, and 34,000 in Los Angeles County. This study has been very successful to date, due in particular, to the way in which city, county and State officials, and Red Cross staff have willingly made major contributions to the study.

### PLANNING FOR EARTHQUAKE PREDICTION RESPONSE

The decade ahead promises to be one of significant advances in the science of earthquake prediction. There is a widespread expectation that earthquake predictions will somehow bring about significant reductions in deaths and injuries, and partial reductions in the property losses that would otherwise occur during unpredicted earthquakes. The promise is there, but the systems and procedures for meeting that promise are not yet in place.

FEMA is planning a cooperative study with State and local governments and the private sector to develop an effective program to respond to credible earthquake predictions.

There are several major areas of concern to be addressed in prediction planning. Each of these would contain components of ongoing (nonprediction) programs, but with special features and adaptations especially suited to the post-prediction interval: Public safety; reduction of property damage; self sufficiency of families and neighborhoods in the immediate aftermath of the earthquake; emergency response; disaster recovery; and economic impact.

A number of related activities will need to be in place so that prediction response plans can provide timely and effective actions. The related activities include: Coordinated prediction evaluation and dissemination procedures; identification of earthquake hazards; seismic codes and mitigation programs; a consensus among earthquake professionals and public officials regarding productive post-prediction actions; public education resources geared to prediction response needs; viable emergency response plans; and mechanisms for disaster recovery planning.

We look forward to a useful and productive alliance with State and local governments in preparing a prototypical earthquake prediction program. While initially we intend to undertake this using southern California as a test region, we expect that the procedural tools and techniques developed will be readily applicable in other large metropolitan areas in which earthquake predictions are likely. This is a very exciting program in which I have taken a great deal of personal interest.

### CONCLUSION

We believe that much has been accomplished under the earthquake hazards reduction program. As is true of most substantial undertakings, much remains yet to be accomplished. We hope that as you view the Federal Program's accomplishments of the last few years, that you will not only focus on that which has yet to be done, but realize the tremendous distance we have covered during this time. We are now at a pivotal point where the public safety can be materially improved with more public education, more effective joint planning, and improved professional practices.

I hope that this assessment of Federal earthquake hazards reduction activities is useful to the committee in its consideration of reauthorization of the Earthquake Hazards Reduction Act. We support reauthorization of this act and look forward to working with other Federal agencies and this committee in further development of a sound earthquake hazards reduction program.

Mr. Chairman, I have emphasized the earthquake program in this testimony. However, I want to assure the committee that we have an equally strong commitment to national security research as well as other research efforts directed at the total range of natural and technological hazards facing the country.

Mr. Richard Green, Associate Director of the Office of Mitigation and Research, Dr. Charles Thiel, Deputy Associate Director of Mitigation and Research, and I will now be happy to answer any questions you have on the specific activities in our earthquake hazards reduction program. Thank you Mr. Chairman.

Mr. BROWN. Thank you very much, Mr. Macy. We do appreciate the report. As you say, it is just one of the first comprehensive reviews of the progress and of the work done under the act. Of course, we have a strong personal interest in that, and we are pleased by the degree of progress that you have reported.

We will try and ferret out any of the weak areas and ask you to deal with those a little more fully as we go along here.

I want to correct an oversight, which I should have done earlier, and acknowledge the presence of a distinguished member of the California State Legislature, who is here in the audience this morning, Mr. Frank Vicencia, who has probably been more responsible for legislation in the field of disaster preparedness and related matters than any other member of the State legislature, and I wonder if Frank would stand up and be recognized. We welcome you here this morning.

Mr. VICENCIA. Thank you, Mr. Chairman.

Mr. BROWN. Mr. Macy, it seems to me that there is a substantial amount of the research involved under the earthquake legislation overlaps with your larger responsibilities under the civil defense preparation and related matters. Am I correct in this? Isn't the problem of managing a possible enemy attack, recovering from that attach and so forth, does that deal with the same type of problems that you deal with in an earthquake or other major disaster event?

Mr. MACY. There is a similarity in the planning response and the recovery areas among the various disasters or emergencies that may face the American people. One of the objectives in creating this agency was to provide for a comprehensive emergency management. It was the belief on the part of the President and the Congress that the joining together into a single agency of the coordinating responsibilities of the Federal Government in those areas would be mutually reinforcing for all of the efforts with respect to different disasters.

I believe that we have a serious obligation to fulfill to the extent of our ability and our resources, the consummation of that particular objective.

Now, the point that you made earlier about the different jurisdictions posed some complications in achieving them. The fact that these functions have been spread among a number of different executive agencies, which are now a part of this organization, poses the problem of integration. That is the management challenge we have in creating the agency, but we do believe that in our efforts to provide particularly more effective research and development with respect to various emergencies that we are reinforcing our preparation for others.

We have a specific example in the work that is being done with respect to earthquakes because there are characteristics of destruction, characteristics of impact upon individuals and structures, that have some similarity, and that as we map the kind of housing difficulties that would be faced in the event of a major earthquake, we are also dealing with what the housing impact might be in the event of an attack or in the event of a serious fire or other threats of different kinds. So I feel that these are mutually supporting programs, and that we should be able to gain further benefit for the American people by combination and interrelating.

One of the tasks is to make sure that that interrelationship occurs. This does not mean that this Agency has the action responsibility. It means that it serves as the orchestrator, as the catalyst, among the various Federal agencies that have the responsibilities in their charters and in their appropriations, and so it is a matter of bringing them together, and in this case it is a matter of working with the U.S. Geological Survey and working with the National Science Foundation and working with the National Bureau of Standards, to have an integrated program, and that the scope of the effort is not reflected in the amount of money or the number of people involved within FEMA's jurisdiction as it is in the totality of the Federal effort.

Mr. BROWN. I think we understand the difficulties that you have in the area of coordination of research and planning, Mr. Macy, and our desire is to be as helpful as possible in this regard.

It would seem to me that a number of things that you had mentioned have across-the-board applicability. I am thinking here, you mentioned the problem of post-recovery housing for large populations. Obviously this is a responsibility that you have to plan for regardless of the nature of the disaster, whether fire, flood, earthquake, or act of war.

I would think there is a large area in which you could have a unified data base, for example, with regard to the various community systems that you have referred to, energy, water, telecommunications, major structures. You recall the problems that we had with dam failures in the not too distant past, which led to a concerted demand that we at least know something about the inventory of dams and their condition throughout the United States. That same situation would occur with regard to knowing about the inventory and condition of other systems that may have an impact on post-recovery operations in the event of a disaster.

There is the need to have available effective communications systems, public education systems, other things of that sort, in order to accommodate the needs after a disaster either on a small basis, which really can be looked upon as demonstrations, while we handle larger systems. If we can't handle the small one, we can't handle the big one.

I think we are interested—I am interested and I think the committee is interested—in knowing the degree to which you are planning for these crosscutting coordinating types of systems; that is, data base, communication systems, inventories of various kinds, and, of course, the general problem of plan of action under a variety of different circumstances.

I am not being as precise as I would like, but I think you get the thrust of what I am saying.

Mr. MACY. I do indeed, and I believe you have pointed out one of the major responsibilities that the Agency has in serving in its coordinating role, and that is the design and assistance in construction of information systems that will provide the kind of data in a timely fashion in order to permit effective response and recovery.

I think that one of the areas of serious deficiency at the present time is the proliferation of systems information without sufficient interconnection to permit this kind of cross use.

We also feel that it is necessary that there be the development of a system that permits us to identify research that is taking place in these various areas and to that end we will have in our applications program a particular effort to see what can be done to utilize the existing systems and to interrelate them in the context of emergencies of various kinds.

There is at the present time the NTIS, which is the National Technical Information Service, in the Department of Commerce. We have the Smithsonian system that has been developed. We will be working with these various existing systems to see how they can be related to the emergency effort.

Mr. Brown. Mr. Macy, we are concerned about those systems and our general reaction at this point is that they are not yet adequate to meet the needs that they were set up for, and what we are concerned about is how these various systems can be integrated, managed, and planned to best serve the national need, and your role here is a key role, and I think you would like to see that role used and we would like to see it used in order to make some progress in bringing about a total system here that is adequate to our need.

There is, in my opinion, no central coordination in the Federal Government for developing an integrated data system or information system that meets either the scientific or technological needs of the Government or the emergency management. Do you have a plan to help meet that, or are you proposing to move toward such a plan?

Mr. Macy. We are proposing to move toward such a plan. We agree that this is a central and high priority concern of this Agency not only in providing the means for central information but permitting dissemination through an effective communications system, so that that information can be delivered to the point where decisions have to be made.

We are finding a need for this, for example, in some of the hazardous material accidents that are occurring across this country with great frequency, and where it is necessary for those that are endeavoring to deal with the consequences of a spillage or an accident to have rather sophisticated technical and chemical information in order to deal with the situation. There are systems that have arisen in response to particular portions of this, some 20 of them at the present time. There is a need to interrelate those and to have some kind of national leadership to assure that that information service is available. I am not in a position today to say that we are on the road to solution on this, but we have this as one of our major objectives.

Mr. Brown. Mr. Macy, I am going to ask Mr. Watkins to take the chair briefly. I have to be excused for just a few minutes, and I will return shortly.

Mr. Watkins, would you take over, please?

Mr. Watkins. Thank you, Mr. Brown.

We do have a couple of colleagues that have been here, I think, and have some particular questions or comments that they would like to make at this time.

Mr. Hollenbeck and Mr. Ritter, I don't know who was here first.

Mr. Hollenbeck. I have a couple of questions, Mr. Chairman.

Getting on a little more parochial note, I notice everyone is aware of the tremendous cooperation you have had in the State of California, and in your remarks you alluded to some of the potential problems on the east coast, which I am concerned with, coming from New Jersey.

I am aware that there have been major earthquakes over the years in Missouri and South Carolina and Boston, in particular. It seems to me that some of the officials in those regions would prefer to forget that they ever happened, and I am wondering first though what kind of cooperation are you getting in the area of direct working relationships with both regional and State and local officials in those areas.

Mr. MACY. We share your view that outside of the west coast and the Rocky Mountain area, the opinion is that an earthquake is of infrequent occurrence, and we need to make sure that it is included within the roster of hazards that may occur. New Jersey has been hit by hurricanes and floods at various times in the past.

Mr. HOLLENBECK. I notice, if I may interrupt, in your listing, the New Jersey metropolitan area I don't think was mentioned. We have several faults in that area. There is the Ramapo Fault across New Jersey, which hits New York over into Connecticut, and I think we have a couple along the Delaware Valley. We have had, I would say, more than a half dozen, maybe 9 or 10, small tremors over the past 2 years recorded along that fault.

What I am really wondering, and I know you are aware of that, are you getting any cooperation from State and local officials in trying to recognize that there may well be a problem there that may have been along those faults a long period of dormancy?

Mr. MACY. In our contact with the State and local officials, we will be emphasizing this as a part of the comprehensive emergency management. It is premature for me to give you any kind of evaluation as to the extent of their activity at the present time. These are State and local responsibilities, but we feel an obligation to be aware of and to have information as to what is going on and to assist them in providing a greater degree of public awareness.

Mr. HOLLENBECK. I think that is important. We have got not only the existence of those faults but the existence or planned existence of a number of nuclear power installations.

Mr. MACY. And a very, very high incidence of chemical and toxic manufacturing plants. I think every State needs to be sure that it doesn't have some Love canals somewhere in its future. We need to identify the potential, particularly in the eastern industrial zone, of that type of hazard. We need to examine our various transportation systems to see how vulnerable they are to accidents of that kind.

So, again, I emphasize the comprehensive emergency management approach in the belief that the bringing together at the State and local level of the planning response and recovery for all of these activities on a coordinated basis would be beneficial and hopefully will be more efficient and economical insofar as tax dollars are invested in those activities.

Mr. HOLLENBECK. Right. Thank you.

Mr. RITTER. Mr. Chairman?

Mr. WATKINS. Mr. Ritter, I think you have some comments or questions.

Mr. RITTER. Yes, thank you, Mr. Chairman.

I think the FEMA budget, Mr. Macy, is about $700 million; is that correct?

Mr. MACY. The budget is actually about a billion and a quarter, but that includes some funds such as the disaster assistance fund.

Mr. RITTER. What is that fund, the disaster assistance fund?

Mr. MACY. What is that fund?

Mr. RITTER. Yes, in terms of dollars.

Mr. MACY. The dollars are $380 million.

Mr. Ritter. And you have $280 million in flood. That is different from disaster assistance, is that right?

Mr. Macy. That is right. And then we have the funding of the insurance operation, which is $500 million.

Mr. Ritter. That is the Federal.

Mr. Macy. Federal insurance program fund. This is to cover the authority for the payment of claims under that program.

Mr. Ritter. As you expand—and I take it the reason for setting up FEMA was to begin to have the Federal Government look into areas other than existing flood, fire, earthquake, and insurance programs, which deal with these different areas.

Do you have a list of the rank ordered areas that you are going to be getting into, and if so, how do you come by such a list of priorities? Obviously there is interest in the hazardous waste situation, there is interest in the nuclear power plant situation, but how do you come by the relative dangers of these different situations, and how do you then make a decision that such and such is dangerous or not too dangerous or less dangerous or very, very dangerous? In other words, the risk has something to do with where the government should be putting its money. Since you have right now programs that are basically taken from other areas and agencies and slapped together, how do you intend to evolve into the new format, FEMA?

Mr. Macy. That is a very basic management and planning problem that we are endeavoring to face at the present time. The budget for 1981 is to a very appreciable extent a confirmation and extension of what had existed with the previous agencies that were taken over. In fact, there was not available time to go through the process that you suggest prior to the submission of the budget. So that we have the mandate upon us to proceed with the administration of existing statutes, the Disaster Assistance Statute of 1974, which concerns response and recovery, the insurance programs that were enacted, and then at the same time to review what additional activities should become the responsibility of this Agency in its responsibility to coordinate the Federal activities.

Mr. Ritter. You are going to have a mellage of things, I am sure—are you going to have someone in the Agency to deal with the rank ordering of your new priorities, or are you going to get involved in looking at the respective risks?

Mr. Macy. Yes; we are in the process of a comprehensive program review to ascertain what the range of our activities are and which of them should receive what priority.

Mr. Ritter. I guess my question, again, is what kind of systemic view will you be taking of potential disaster in order to arrive at your priorities?

Mr. Macy. We will be looking at the degree of threat to the life of the American people. Our objective is to reduce, to mitigate, the degree of hazard faced by them from various threats, and we will be assessing that on a nationwide basis and with the States and localities in terms of their particular needs.

We also anticipate that there will be programs assigned to us because of the existence of this Agency where there has been no requirement previously. A specific and important example of that is the assignment by the President of a responsibility to this Agency to work with the States on a review of their emergency planning effort insofar as the offsite preparations with respect to a potential nuclear plant accident. Previously this was a secondary concern of the Nuclear Regulatory Agency.

Mr. RITTER. What do you mean by offsite?

Mr. MACY. By offsite I mean those effects which occur from the nuclear accident outside of the plant itself; in other words, the impact of an accident upon a particular community.

Mr. RITTER. Is this again, in assessing the degree of threat, as you put it, or in a sense comparing risk, what is coming first, and I guess this is my real question: Are you going to respond in a way that is somewhat logical in terms of assessing and ranking these priorities of threat, or will you be doing that and then going ahead and doing something else at the same time because there are demands on your Agency?

Mr. MACY. We will endeavor to go through a rational evaluation process, but we also recognize that there are conditions that will result in assignments to this Agency to meet certain emergency conditions that may not fall within the logical ordering of individual hazards.

Mr. RITTER. What do you mean by that?

Mr. MACY. Well, I mean, again, to return to the nuclear hazard, the record of accidents in that area is one that would not put it high in the order of threats, but nevertheless because of the national concern for the safety of those plants, there has been a determination that there should be a stronger set of standards in the emergency planning for the communities that are in the area of the plant. So this has been assigned as an additional function for the Agency.

Mr. RITTER. Is the function of spending the taxpayer resources in response to perceived risk actually costing us in lives because we have not responded to the logical and real threat?

Mr. MACY. I don't quite follow your question.

Mr. RITTER. You know, safety and the expenditure of public taxpayers' funds for safety will save lives.

Mr. MACY. That is right.

Mr. RITTER. I mean that it will cause greater public health. I think this is why we do it. We must start with that premise, and if you don't have a strong program to rank order logically the threats that we face, we will be getting involved in spending perhaps vast sums of taxpayers' money in areas which may not produce any increase in health and well-being, and may at the very same time lead us to ignore those areas which would produce increases in health and well-being and save lives. Therefore by Government policy we are, you know, to some extent, killing people.

Mr. MACY. Certainly our effort is to be the Agency that conducts this kind of comprehensive review of hazards and potential impact.

Mr. RITTER. I think all of these hazards must be included because if you say, whatever the political outcome of a hazard, that you must put your resources in—and that is going to be a political decision obviously in the final analysis—you still need to go through this process. You cannot exempt this particular disaster because there is a very high degree of media action on it. It may be nuclear, it may be one of a half dozen other things. It is the responsibility of our Government not just to follow that which is in an emotional high level of vibration, but it is also the responsibility of our Government to bring the kind of information back to the people so that they can have better understanding of the very nature of disaster and its management.

Mr. MACY. I think for example, Mr. Ritter, of the fire program. Fire has been with us so long and is so much a part of daily hazard that there is a tendency to overlook the magnitude of loss both in life and property.

Mr. RITTER. I want to point out to this entire audience here that last year, a year ago, there were 42 deaths from woodburning stoves in Vermont. The year before there were zero, at least zero reported deaths, from woodburning stoves in Vermont. That is Vermont alone. That is from the misuse or mishandling of woodburning stoves, and that isn't something that you need a Federal emergency management plan for.

I think this whole idea of where the society needs to put resources must have a very realistic basis to it or God knows we will be wasting enormous amounts of money here. I think fire prevention is effective. That is where our people are dying. It is every bit as real as a potentially feared death that will come from a chemical hazard or potentially feared death that is going to come from nuclear power.

Mr. MACY. There are 25 deaths a day and the property losses amount to $5 billion a year.

Mr. RITTER. The average citizen is going to be affected by that fire, and the citizens must understand that this is priority, and to the extent that you will be defining those priorities, I hope there is a logical system for evaluating those threats and not simply having a list of threats which have been properly evaluated and outside of those have two or three threats which are in vogue in the media and large amounts of spending will give very small amounts of mitigation.

Mr. MACY. I agree with you, and I have stated that part of our objective is to think about the unthinkable, those that do not attract media attention. So that this is a responsibility of this Agency.

Mr. RITTER. Those that have the reality of people wounded, sick, hurting and dying, I think should be our first priority in the Federal Emergency Management Agency. I share that view, and let me also add that it is important to recognize that dealing with these emergencies is not exclusively the Federal Government's province. In the great range of emergencies, they are traditionally the responsibility of local government with the States. The Federal Government has entered the picture in recent years because of the magnitude of some of these emergencies and because of their interstate character; and as we approach our responsibility in this Agency, we feel that our intent is to supplement, augment, and extend the efforts of the State and local officials rather than to supersede them.

Mr. MACY. And I would hope to do it on an intellectual plane, which is worthy of spending vast amounts of taxpayers' money.

Mr. RITTER. Thank you, Mr. Chairman.

Mr. BROWN. Mr. Hollenbeck.

Mr. HOLLENBECK. I have a further question of Mr. Macy. In view of the legislative mandate for the earthquake hazard reduction program, and in view of the plan that you have laid out in your lengthy statement, do you think that your fiscal 1981 request is adequate to meet that? It looks small to me.

Mr. MACY. It looks modest, doesn't it?

Mr. HOLLENBECK. Yes, it is very modest. I wonder if you could address yourself to this: Is there a reason why you made such a modest request at this time?

Mr. MACY. Well, our view is that the bulk of the funding for programs in this area is provided to other agencies. They are provided primarily to the U.S. Geological Survey and the National Science Foundation.

Mr. HOLLENBECK. That is about how much?

Mr. MACY. It is about $55 million. I think ours is a modest request. If we had had more time before we were required to submit our budget, frankly, it would have been of larger magnitude, but we are in the initial stages of our own activity. There had not been any funds designated for this purpose in the previous years. We believe this is a good initial start. We would see a continuing growth over a 5-year period, with a portion of that growth reflected in the requests from this Agency, but we stand by the request that we have here at the present time for 1981.

Mr. HOLLENBECK. Thank you.

Mr. BROWN. Mr. Macy, you have indicated one or two areas of weakness in the research program. You haven't dwelt on them, which is appropriate in light of the fact that in general you have to take the posture of defending the present budget; but, your statement says that applied research support tends to be lagging in the opportunities presented and development related activities are proceeding more slowly. Then you also point out the areas of social, economic, administrative, and political science research is a minimal effort underway. This is not news to us, and we would like to see stronger efforts in these areas.

I don't want to, obviously, get you in a position where you are opposing the policies of the administration, but let me ask you a hypothetical question with regard to the scope of programs in these areas that would be desirable if we were not acting under strong fiscal constraints at the present time. What would be a rough order of magnitude that programs in these areas really could utilize profitably?

Mr. MACY. I would feel that another $10 million would be a desirable and effective extension of the present program. It would not overcome the deficiencies that I have identified in my statement, and I would never intend to come before you and say that we have satisfied all of the objectives. I think one of the problems with emergency management is that there is never a 100-percent belief that all that is necessary has been done, but I view the earthquake problem as a very serious high priority hazard on the list of disasters for this country, and I believe that this reflects a minimum effort, and I would expect to come before you in future years, God willing, and call for more extensive effort in order to meet those goals.

I would be pleased to have Dr. Thiel elaborate on those points because he is very familiar with the status of these programs, if that would be beneficial.

Mr. BROWN. I would be very pleased to have Dr. Thiel elaborate on that and to give any refinement to that answer that you might be able to give.

[The biographical sketch of Dr. Thiel follows:]

## CHARLES C. THIEL
DEPUTY ASSOCIATE DIRECTOR
OFFICE OF MITIGATION AND RESEARCH
FEDERAL EMERGENCY MANAGEMENT AGENCY

Dr. Thiel is responsible for research and mitigation programs in the Federal Emergency Management Agency that focus attention on those classes of events that are likely to produce serious threats to the safety, health, and welfare of large numbers of people and to cause significant damage and social disruption. This includes a broad spectrum of disasters, emergencies, and hazards: (a) natural, geophysical disasters, such as earthquakes, floods, hurricanes, tornadoes and other severe storms, etc.; (b) technology-induced hazards, such as urban and industrial fires, large-scale explosions, and the release of toxic, chemically reactive, and radioactive materials in populous areas; (c) catastrophic failures in key network and distributive systems, such as electric power blackouts, and the disruption of other public utility and transportation systems; and (d) intentionally produced emergencies and disasters, ranging from peacetime acts of terrorism, sabotage, vandalism, and blackmail to wartime conventional and thermo-nuclear warfare.

Prior to joining the FEMA staff he was Head, Earthquake Hazards Reduction Group within the Office of Science and Technology Policy, Executive Office of the President. This group is responsible for coordinating earthquake hazards reduction activities of Federal departments and agencies. He has retained these responsibilities with their transfer to FEMA.

Dr. Thiel serves as Chairman of the Interagency Committee on Seismic Safety in Construction. It is developing seismic design and construction standards for Federal projects and guidelines to assure serviceability of vital and critical facilities.

At the National Science Foundation, Dr. Thiel held a variety of positions, most recently as Division Director, Problem-Focused Research Applications. In this capacity he was responsible for the administration, planning and implementation of the PFRA programs in environmental risk management including earthquake engineering, chemical threats to man and the environment, and societal impact of natural hazards. Prior to this Dr. Thiel was a Professor at Purdue University and a research engineer for the General Technology Corporation.

Dr. Thiel was born in 1940 in Chicago, Illinois, and received his education at a number of schools throughout the country prior to receiving a Ph.D. in Engineering Sciences from Purdue University. He has authored a number of technical papers and presentations. Dr. Thiel is a member of the Earthquake Engineering Research Institute, Building Seismic Safety Council, American Association for the Advancement of Science, American Society of Civil Engineers, Seismological Society of America, Consultative Council and Tau Beta Pi. Dr. Thiel is the recipient of the National Science Foundation's Meritorious Service Award (1976) and the Arthur S. Flemming Award (1976). He resides in Alexandria, Virginia.

10/79

## STATEMENT OF DR. CHARLES THIEL, DEPUTY ASSOCIATE DIRECTOR, OFFICE OF MITIGATION AND RESEARCH, FEDERAL EMERGENCY MANAGEMENT AGENCY

Dr. THIEL. As Mr. Macy has indicated in his statement, there are in our belief substantial opportunities in the area of developmental and applied research activities. The nature of these principally center around the practices of individual professional designers, individual decisionmakers within the community, and within the governmental context of the community.

We have developed a very large library, a catalog of information which we know from a research and experience standpoint. The fact remains that we are not applying much of that which we know. Some of the reasons for this have to do with the observations you made earlier, and on other occasions, about the availability of information systems and ready access.

I would suggest that probably a more pressing need at this point is to increase applied research activities that allow you to make basic research observations usable by nonresearchers and furthermore to synthesize, evaluate, test and prototypically apply those applied research observations and experiences so they will be ready to be used by a practicing engineer, an architect or city building official.

We have not, with the exception of the applied technology council project which Mr. Macy referred to in his testimony made a concerted effort to develop codes of practice, standards of practice, and professional criteria for application in the building, architectural and construction trades. While we have given a great deal of attention to the theoretical and isolated performance capabilities of building components, we have not translated that knowledge into a performance understanding of building systems, and furthermore we have not done the applied research on the building systems that leads to something a code official can actually apply. So I think we have a great deal that we can do in the mechanical sciences.

In the social and policy sciences, the management sciences, I think we have probably the greater challenges before us. Typically, public officials want to make the normative decisions for their community on what constitutes a safe enough environment: That is appropriately so. They are not presented, however, at this time with an appropriate understanding of the interrelationships of their actions and the measures that can be used to judge their effectiveness.

We have not looked, for instance, at the interactions between fire safety issues and earthquake safety issues. These are concomitant hazards. We have not looked at the administrative procedures that are undertaken by a community to regulate growth or subdivision planning or master planning, and the way in which they either enhance or decrease earthquake safety, or the ways in which earthquake safety might contribute to increasing flood hazards.

So we have a large amount of ground to make up looking for policies, procedures and impacts of those policies and procedures, so that a private individual can make informed explicit decisions on their safety as opposed to now, as Mr. Ritter has properly said, intuitive guesses that are not based upon normative facts.

Mr. **Brown**. Are you in the process of developing adequate research plans in these areas so that you can make adequate use of resources if they were available to you to carry out the sort of things that you have indicated?

Dr. **Thiel**. I believe we have initiated that process adequately. We had a major effort with the U.S. Geological Survey, the National Science Foundation, and the National Bureau of Standards this past fall to develop a group of scientific opportunities, approaching it from a ZBB budgetary basis. We are in the process, in cooperation with the other agencies, in finalizing that document, so that it can be a successor to the program developed for Dr. Stever when he was the President's Science Advisor, and often referred to as the Newmark plan.

Mr. **Brown**. I want to be satisfied that that plan is going to include the applied research and socialeconomic administrative, and political sciences research, which is where the weaknesses are.

Now, I pay high tribute to the research of the Foundation and the Geological Survey and the other agencies in the field of geosciences and related work. They have an outstanding record, and as a matter of fact, it is the almost explosive successes of their research in these areas that has led us to the problem now of developing an adequate social-political competence to deal with this.

Now, we are these same people going to be equally adept at producing the other kinds of plans? That is the question I have in my mind. And, of course, I haven't familiarized myself in detail with the work that you mentioned here, and I will have to take your assurance, if you can give it, that this is being adequately treated in the research plans that they are working on.

Dr. **Thiel**. I must say that, in my judgment at this time those areas are not being dealt with adequately. But I will assure you that as long as I am involved in this process we will treat those adequately and appropriately. It is my personal commitment to see that that is accomplished.

Mr. **Brown**. We will dwell a little further on that as we go along during the week. If I may, I would like to get back to this question that I referred to earlier, of the development of disaster infrastructure, I guess you may call it, the kind of cross-cutting systems which are necessary in order to mitigate the effects and accelerate the recovery from any kind of disaster. I still don't feel in my mind that I understand well enough what you have underway. I am not asking you to have a complete program or anything, but I am interested in the degree to which there is planning going on which will lead to an integration of the needs in all of the disaster areas to provide the structures.

Now, we might mention communications systems, for example. I have a little but about wanting to utilize all this great new telecommunications technology that we are developing, satellites, and all of the electronic developments and so forth. I see no reason why we couldn't, theoretically at least, have a dedicated public service emergency communications framework for the country. Maybe we have. I know the military has. But it seems to me that we need this in the civilian sector to be prepared for breakdowns and disasters of various kinds, and I want to raise the question with you as to the amount of thought and planning being done in order to consider the possibility of developing systems of this sort.

Mr. Macy. This is very definitely within the scope of our concern. One of the predecessor agencies, the DCPA, conducted extensive research with respect to the utilization of satellite communications in connection with civil defense, and we are continuing and broadening that approach in the efforts that we are undertaking.

I have had meetings with the NASA leadership. They have assured me of strong cooperation in our exploration of this particular possibility.

We are not at the point where I could give you a specific recommendation as to what design would be most effective, whether we need a dedicated system or could utilize some of the existing capability that exists. But our view would be that it is essential that in emergency management in the development of a capacity and a survivable communications system that we utilize the latest technology.

I recall that Jim Webb, when he was NASA Administrator, was always talking about the civilian spinoff as one of the greatest benefits of the space program. While I would like to see us confirm the fact that there can be benefits in the interest of our population in utilizing those systems. Dr. Thiel has some additional developments that he can report on for you in order to give a more precise accounting of where we are.

Dr. Thiel. There have been several research studies investigating the question, particularly for defense purposes, of emergency communication systems, including satellites. There are some specific problems associated with satellite communications under military circumstances. If you would like, we can certainly supply you with copies of the reports that have been prepared in that area.

Mr. Brown. I would appreciate it if you would.

Dr. Thiel. In the area of civil disaster response, there is quite a bit of controversy about whether indeed such a system would be cost effective or not. There generally is very wide availability of communications systems in the disaster region. There are often problems, however, that develop because different communications systems from different jurisdictions are not frequency compatible. Whether this same problem would exist if there was a master communication or satellite communications system is open to some question.

If there is such a system, you have properly identified it, I believe, as having to be a public service system with high power. In other words, to allow low-power uplink so you could use walkie-talkies or something of that order as opposed to large ground stations. It would make it very effective quickly.

The one area in which there seems to be some concurrence in the utility of this type of system is in the wilderness emergency situation, in which you are trying to search for individuals in a coordinated way that may have come down in plane crashes or rural areas that have been subject to earthquakes, floods or winter storms, and things of this nature.

Mr. Brown. You are undoubtedly aware that NASA is proceeding with search and rescue programs?

Dr. Thiel. Yes.

Mr. Brown. What I see here is various components of an integrated system being successively defined as being feasible, but no planning being done for a total system. Let me give you an example from the

Army. They have a very well coordinated computer command office, which is located nearby in Arlington, and apparently they have the capability for any Army unit anywhere in the world, if its headquarters company were to be destroyed, and all data with regard to the personnel and equipment and so on, which is stored in the computer there to replicate that from another source and reconstitute the data base.

Now, essentially this is the problem that you are faced with in the event of a civilian disaster which destroys a data base that is important for the ongoing functioning of a civilian. I think it is deplorable that we haven't done the thinking which allows us to organize our data base, store essential emergency data in a safe place, and reconstitute it easily in the event of an emergency. A military commander would know how to do that, and yet I think that we just haven't thought about that. Now, apparently it is unthinkable in the civilian sector. Now, I think you have to think about it.

Mr. MACY. We do have to think about it.

Mr. BROWN. I think as far as I know that is your job.

Mr. MACY. That is our job. This is one of the key areas of our concern in terms of any kind of attack on the United States, but it has to be applicable to the natural and man-made disasters as well.

Mr. BROWN. It is more than an attack. If the city hall or the county hall records are lost in Los Angeles when there is an earthquake you are going to have a problem there. You may have to reconstitute your whole system of land records, for example, without which the economy won't function. There are a lot of things that need to be included in a comprehensive planning effort, and I pick on Los Angeles and southern California because I am most familiar with it. But New Jersey would have the same problems in the event that a chemical plant exploded and knocked out vital information or vital systems within the area, and our planning needs to keep up with the technological capabilities that we have. I think they are getting way ahead of them.

Mr. MACY. They are and we need to have this kind of thinking with respect to application in an early stage in future technological development. I think that one of the obligations we have is to provide an indication of the requirements for application in emergencies to those that are engaged in research and development. This is one of the reasons why we have created within the Agency a separate unit that is concerned with research and development, to provide that kind of linkage between the planners and the responders.

Mr. BROWN. There is obviously a great deal more that we need to know about what you are doing and that you need to know about what we are thinking than we will be able to get out here this morning, but I would like to express the hope that possibly I or the committee staff can get together with you and Dr. Thiel and see if we can get a better understanding of what we are into here, and this includes the possibility that we might want to have, say, a joint hearing involving this committee and the appropriate subcommittee in the Armed Services Committee to look at this interrelationship problem that is a very serious one, it seems to me.

Mr. MACY. We would welcome that. I am sure that we can gain a great deal of guidance from the committee and its thinking and any kind of linkage that we can establish with other jurisdictions will be beneficial.

Mr. BROWN. Mr. Hollenbeck, do you have any further questions?

Mr. HOLLENBECK. No.

Mr. BROWN. Do you have anything, Dr. Ziman?

Dr. ZIMAN. Thank you, Mr. Chairman, I have some questions.

As you are well aware, there are problems that will arise with predictions of an earthquake. The city of Los Angeles is the only locality so far that has even prepared a report dealing with earthquakes and responses. One of the major things they raise in this report is how to deal with prediction in the period between the prediction and the event itself. They raise questions about disaster relief funds being available then and also about what the Federal agency role is in this, both in terms of providing funding, and in coordination and cooperation with the city government.

What are you doing with regard to this problem?

Dr. THIEL. Yes; as Mr. Macy indicated in his statement, we have made a commitment to a joint Federal, State and local planning effort to prepare for the prototypical southern California prediction. This is not going to be pursued as a sterile planning effort, but will be pursued to develop the specific tools, the actionable items, and guidance for use by both the public and private sector, ranging from the question of how the media should deal with the question of identifying qualified and competent professionals to advise the public down to the very nitty-gritty question of should you turn off the natural gas in your house or not.

A major component of this is to deal specifically with how predictions are aggregated out of the research community and the evaluation community, and then pass down the chain to the citizen.

As it stands right now, for predictions that arise outside of the context of Government programs, there is no orderly communication mechanism to get the information from the predictor to the citizens. We have in our civil defense activities over the period of the last 30 years developed a highly efficient, very rapid, communications system to virtually every political jurisdiction in the country. Over the next month we will be activating that system to communicate earthquake predictions and warning information.

I would like to emphasize there is a difference between prediction and a warning. A prediction is a statement of fact, an expectation of a particular physical event, at a time and at a place, and at a magnitude.

A warning takes not only the prediction information but other information which an individual community, a family unit, can use to actually decrease their vulnerability to the predicted event. So we will be dealing very much with the warning preparedness activities.

We hope to cooperate with the State, with the cities, with the special districts of the area, with the county governments, the variety of private and political institutes that operate within the area.

Dr. ZIMAN. With regard to predictions and FEMA, are there any problems in terms of a line of authority and also legislation needed to define further exactly who has what authority in terms of making or issuing orders?

Dr. THIEL. In terms of the authority to issue predictions and warnings, FEMA clearly has that responsibility and legislative capability. There is some question in the minds of the various officials within the Department of Interior as to whether they have that authority under existing legislation. I think that any questions about that lack of authority will very quickly evaporate, however, in the circumstance of a prediction being imminent. I think that the prudent public official will act to announce that information, scientific or otherwise, which he has, that bears on the public safety.

Dr. ZIMAN. You made a conclusion to the California report, the report of the State of California, that they are ill prepared to handle an emergency. What will FEMA's role be in dealing with a State like California and helping them upgrade their emergency preparedness? What do you intend to do in this area, if anything?

Dr. THIEL. Assemblyman Vicencia and I are having a meeting this afternoon to explore questions of this type. We also have had contacts between FEMA and the California Seismic Safety Commission, the, office of emergency services, and the divisions of mines and geology, as well as local institutions.

We are currently exploring how we can specifically cooperate in that partnership. If I may say, it is relatively clear to me that neither the Federal, State, or local government have the resources or the capability to respond to a major prediction or a major event alone. It must be a cross-jurisdictional cooperative effort. We are committed to cooperating with the State and the local government.

To reiterate what Mr. Macy said earlier in response to another question, earthquake safety is essentially a State, local and private responsibility. It is our responsibility at the Federal level to try and provide those incentives which are appropriate from the Federal standpoint to encourage safety and to make sure that disincentives are not present at the Federal level to prevent other members of society from responding to real and meaningful threats.

Dr. ZIMAN. This raises a few more questions. One is the public education question and FEMA's role in dealing with this, and the second is planning grants to various localities to help them along in terms of devising mitigation plans. Again, what is FEMA's response in these general areas?

Dr. THIEL. With regard to public education, we are currently investigating what are the most appropriate ways for FEMA to respond to not only earthquake public education issues but also a variety of hazards. As Mr. Macy has indicated, when you deal with public education either of young people through the school systems or to adults you are dealing with it in an environment in which you must deal with the variety of hazards to which they must respond.

It is generally believed that for the noncrisis public information issues that you are best advised and will have the most impact on members of the public, if you will approach it from an all azadrsh point of view. We are investigating that at this time.

During the crisis stage, that is when a prediction has been issued or is anticipated by the public or when you are in the immediate post-disaster period, during the emergency period, and the reconstruction period, these are times when you want to have very specialized items and pieces of information available. It is generally observed that during these crises expectant or response phases, that anything that you have not done beforehand can't be implemented afterwards.

We are specifically examining—and I have a staff man working on the question of what our response ought to be—what our planning ought to be, to respond to that crisis, which is expected.

You asked a question with respect to planning grants and activities. Under the Disaster Relief Act of 1974, after several unsuccessful attempts under previous legislation, the Federal Disaster Assistance Administration, one of the component parts of FEMA, made individual disaster grants with each of the 50 States. They were 100 percent funded activities, with followons in $25,000 per year to prepare for disaster emergency response. These programs have been principally emergency response related and have not responded to questions of mitigation and other approaches to hazard reduction.

It was considered in the process of developing the Federal program, the national earthquake hazards reduction implementation plan, whether it was advisable to make specific planning grants to communities and States for earthquake preparedness. Noting the success and in some cases lack of success of very comprehensive civil defense programs, where we paid 50 percent of the salary costs of individuals in each community virtually, it was decided at the Presidential level that such programs were inappropriate for earthquake specific issues. We are investigating some prototype or demonstration programs that we might test to providing models whereby communities might decide whether to accept or reject programs or policies. But beyond that level we are not considering any specific activities with State and local governments.

Dr. Ziman. No further questions.

Ms. Giorgio. If you issued a prediction right now that would cover the next 6 months, what in addition would FEMA do for the locality for whom the prediction was issued?

Dr. Thiel. There are certain difficulties in the question that you pose. Under our existing legislative authority to act specifically, that is the Disaster Relief Act, we may only act when the President has declared a disaster, and that disaster may only be declared after the State, the Governor has certified that State resources are inadequate to respond to the physical damage and disruption that has taken place.

At this time, as I understand our law, we would not take any specific actions that were hazard abating or reduction related. We would make available to the Governors, to the local communities, and to the public in the area the full range of that which we have learned through research and experience in the earthquake area, civil defense, and related hazards. I believe we could provide them with a substantial amount of technical assistance, but that would be limited to technical assistance and information.

Mr. Macy. It would be our expectation that in earthquake prone areas there would be an ongoing communication with the State officials so that there would be an exchange of information and there would be an indication as to what respective capabilities would be in order to respond. But, as Dr. Thiel has indicated, the disaster assistance mechanism can only be triggered in the event there is a gubernatorial request to the President and the President declares the emergency.

Now, we found in recent major emergencies, such as the hurricane on the gulf last year, that that process can be shortened very materially, and that in a matter of a relatively short time it can be accomplished and the Federal actions brought to bear in response to the particular emergency.

Ms. Giorgio. Thank you.

Dr. **Thiel**. I wonder if I might add just one thing.

Mr. **Macy**. Please.

Dr. **Thiel**. In the postdisaster period, it is FEMA's responsibility to be the Federal manager of the disaster—not the manager of the disaster but the Federal coordinating function is discharged by us, and in this way we have access to the full resources and personnel capabilities of all Federal agencies. I think it is important to note that in this period we are principally a coordinating agency.

Mr. **Macy**. The Federal coordinator is designated by the President from within this Agency, and that coordinator assumes Federal responsibility for the full range of departmental and agency resources that are available for that purpose, and is the single point of contact with State representatives and local representatives who are seeking assistance from the Federal Government.

Mr. **Brown**. Would you change your title and call you General Macy or something like that?

Mr. **Macy**. No question, we will still keep it civilian.

Mr. **Brown**. Let me ask you one question, Mr. Macy, that has occurred to us. Have you been able to identify or have you tried to identify any net savings resulting from the reorganization of various separate functions in FEMA such as, for example, consolidation of local or regional offices or things of that sort?

Mr. **Macy**. We are still in the process of attempting to meet the goals set for reducing the total funding of the agencies that preceded us. There are a number of areas where we believe we can make more effective use of staff, and one of them is to consolidate regional offices of the several agencies into a single location and to make that location the standard regional centers, so that the FEMA staff will be available to work closely with regional representatives of all other agencies.

We believe that if we are able to consummate that arrangement, which entails moving some people from other locations, that we can have beneficial results. The degree to which they will be reflected in savings is still to be determined.

Mr. **Brown**. All right. One final question.

Dr. **Ziman**. Thank you. You have answered a part of it, but one or two things still disturb me. That is, you have five different directorates here. When you have an earthquake specifically, you have to have coordination within these directorates in terms of response, in terms of disaster preparedness, hazard mitigation. Have you developed a work plan yet to address this, and also who within these directorates will act as the lead to take this responsibility? If you don't have a working plan, when do you expect you will have one?

Mr. **Macy**. I think there are two organizational answers to that. One is that I look to Dr. Thiel as the project manager in the earthquake area. He is responsible to me for the execution of the program in accordance with the mandates of the program, and he is working with all of the components within FEMA in dealing with the earthquake incidents. As you indicated, there are areas of responsibility in planning and preparedness and response and recovery, as well as in the research area as there are direct connections with respect to the insurance program, the fire program, and our training and education. In the event of an emergency, we would move to the Federal Coordinator concept. This would be a trained person with senior responsibility out of the disaster response and recovery organization, and as that individual coordinates, other Federal agencies would coordinate whatever supportive effort came from other elements within FEMA.

Mr. **Brown**. You still haven't told me that you have developed a plan. What is your time frame on this thing?

Mr. **Macy**. I would say within the next 90 days we would have such a plan.

Mr. **Brown**. I would like to see it when it is finished.

Mr. **Macy**. We would be happy to submit it to the committee.

Mr. **Brown**. All right. We thank you very much, Mr. Macy and Dr. Thiel, for your patience with us this morning.

We have, of course, a lot of work to do for ourselves to achieve the comprehension of a complex program that you have which will enable us to make judicious decisions, and this certainly has been very helpful to us. We thank you very much.

Mr. **Macy**. Thank you for the opportunity to meet with you, and we will look forward to further sessions. You will see more of us than you ever wanted.

Mr. **Brown**. Thank you very much.

We stand adjourned until 2 p.m.

### Afternoon Session

Mr. **Brown**. The subcommittee will come to order:

This morning, we began 3 days of hearings on the authorization of various programs within the Federal Emergency Management Agency which falls within the jurisdiction of this subcommittee beginning with the earthquake program, and this afternoon we focus on the problems of fire.

And we have with us Mr. Macy returning as the Director of the Agency and Mr. Gordon Vickery, Administrator of the U.S. Fire Administration.

Do you have Mr. Moreland here?

Mr. **Vickery**. Yes, sir, he is available here.

Mr. **Brown**. As back up?

Mr. **Vickery**. Yes, sir.

Mr. **Brown**. So I will not detail your distinguished record, Mr. Vickery, if I recall correctly, you came from local government in Seattle, and even though that is not in California, it is close enough, so that it confers great distinction on us.

Mr. **Vickery**. Thank you.

Mr. **Brown**. We are very happy to have you here and to hear your report with regard to the Fire Administration and the full text of your statement will be inserted in the record, and you may present it in whatever fashion you think will be the most useful.

## STATEMENT OF GORDON VICKERY, ADMINISTRATOR, U.S. FIRE ADMINISTRATION

Mr. **Vickery**. Thank you, Mr. Chairman, and members of the committee.

We are here, of course, to encourage your support for funding of the U.S. Fire Administration and to make a progress report to you about what has been occurring since I was here just a year ago.

As you mentioned, Congressman, I did spend some 35 years in municipal government. Please bear in mind that I am making some judgments probably as they apply to jurisdictions involving municipalities. I think the fact that I did spend a little bit of time in a volunteer fire department in a small community also allows me to share with you some feelings I have been able to accumulate over the past years as I traveled around the United States.

The fire problem, of course, continues.

It has not diminished in the degree that all of us would hope and I guess to—I was in Seattle and San Francisco during the past week and a statement was made that I think serves to capsulize my feeling and a lot of other people's feelings about lack of awareness that the American citizen seems to have for fire.

A statement was made that the life loss from fire each year in the United States is the equivalent of two 747's running together once a month and killing everybody on board in both airplanes.

That is just about what it amounts to in the number of lives lost, and I think as we look at the incident in Chicago, you can recognize the tremendous uprising of the government and citizens to a problem that involved a little less than 300 lives; certainly a tragic loss, but here we have the equivalent of two major airplanes running together once a month and killing everybody on board and we can't seem always to get public attention.

I think we are making headway, and I think it might be appropriate at this time as I talk a little bit about the four major program areas, we have to state what is rather obvious should be the objective of not only the U.S. Fire Administration, but certainly the Federal Emergency Management Agency as we work together addressing this problem.

The fundamental objective, of course, is to reduce fire loss and the level of risk from fire by whatever means are necessary. There are a variety of methods that are being used with some new ones that have come into being just this past year. I will sum up with those.

I think we should talk very, very briefly about the four major program areas that we have at the U.S. Fire Administration and within FEMA that do address this problem.

The first one that helps us define the problem, and also allows us to reach the end user is the National Fire Data Center.

The Data Center is only 4 years old and has been growing very rapidly. For the first time it has really been able to accumulate the hard data we need at the Federal Government to make some decisions for ourselves and for you as to how the money would be expended that the Federal Government may allocate to this particular task.

I think one of the things that is forgotten when we talk about data being available for use by the Federal Government people in allocating their resources is that one of the fundamental reasons for the data program is to allow local officials to better program their resources. I think anyone that has worked at the community level or the State level recognizes that we have never had definition in the past, acute definition of the fire problem.

We have never had a program or at least a structured program that addressed itself to using what available resources there were to reduce the significance of the fire problem.

I think we have that now. The major emphasis that we place out in the local area is that the data they are collecting and funneling through the State and on in to the Federal Government is not just for our use but can be extremely valuable and really the only means they have of using resources wisely in addressing the fire problem in the local area.

It is a very definitely local tool. As I look back at the past year, I think it remarkable that we have 36 States that are either actually reporting or in the process of completing the data systems. I think it is rather remarkable that we have been able on really a leverage basis to give States a relatively small amount of money, some technical assistance in the software and have that many States and localities within those States that are voluntarily reporting into a data system which ultimately serves us all.

I think that in the past years, as I have observed it, we can report only pluses in the progress of the National Fire Data Center.

The research within the U.S. Fire Administration, or technology transfer as I prefer to call it, occurs within the National Fire Data Center. We have a number of programs going on that address themselves to fire fighter health and safety and to better equipment, not only for firefighters but for their communities.

We have a number of other assessments that are starting where a community will be able to judge whether it is appropriately manning its companies. We have given it the term resources allocation. This has the endorsement not only of the International Association of Fire Fighters, but the various public groups that we find throughout the United States. I think anyone that has worked in almost any political jurisdiction in the United States recognizes that we have never really made the assessment that we should have of fire capability, fire resources, and how we address them to communities.

It is rather ridiculous to find in the United States two cities of approximately the same population working the same hours, same shifts, with one department having 1,900 people and another having a thousand. Something is wrong one way or the other.

We know that the manning of companies and firefighter strength can seriously affect firefighter safety and health. That it costs upwards of a quarter of a million dollars, as high as $600,000 for a fireman to be pensioned off early.

We think the ultimate return from the studies we are just starting that relate to fire department manning, the allocation of resources in communities is going to prove extremely valuable nationwise.

Another area that has gone relatively unexplored in the past is what are you really doing for residential fire safety in the matter of research and research application or technology transfer. We have a number of programs under way that relate to smoke detectors, the effectiveness of smoke detectors, and in California, particularly, we have been working on programs which have to do with home fire sprinklers.

Sprinkler installations in buildings, permanent sprinkler installations, have been pretty much a matter of commercial or industrial occupancies in the past. We do have an extensive list of areas and programs that are addressing themselves to testing, using, and seeing how sprinklers can be used to reduce the life loss in residences.

I might mention that all of the results to date look very, very promising. There are a number of communities, particularly in California who are ready to enact codes which change the methods of building residential areas in their city if these tests prove worthwhile. We think they will.

Another area in which the Data Center has involved itself quite heavily is the matter of codes and code enforcement.

How well a community or jurisdiction enacts codes and statutes relating to fire that provide a safe atmosphere and a safe living environment for their tenants, can be one of the ultimate long-range answers to reduction of fire loss and the reduction of life loss.

Since I was here last, the National Fire Data Center is on a very positive note and there are a number of programs there that I think political jurisdictions within the United States not only can identify with but are starting to use the product.

Another area within the U.S. Fire Administration is the Office of Planning and Education.

At times this is a misnomer. When we use the term education, people begin to think of the National Fire Academy. The Office of Planning and Education is really a different type of education and in trying to define that in my own mind so that I could explain it better to you or others. is that the Office of Planning and Education has to do with public education. How we educate communities, areas, States, regions, or jurisdictions.

And in the sense of educating the public. When we talk about training in education at the Academy we are talking about training in specifics for firefighters.

The primary mission of the Office of Planning and Education is the development and dissemination of effective loss reduction programs.

We try to go into States and into local areas. We have a number of programs underway at the moment. One is called the planning, education and assistance program, where we will go into a State and show them model programs which they can use. We encourage them then to pattern their State programs after the one that we have shown them that is working in some other jurisdiction.

An area that I think particularly appeals to municipalities of all sizes is master planning. At the present time, we are working with multicounty use of this particular plan, which did evolve from California. In other words, how do you look at a community's fire problem, how do you look at its resources, and how do you match those two. Finally, how do you maximize resources to best serve a community.

We are in the process of teaching, explaining and coordinating master planning nationwide.

We have some individuals under contract who are working with various jurisdictions in the United States.

Certainly, one of the areas that you heard a lot about and will continue to hear a lot about and in which FEMA has taken a major role is the matter of arson and addressing the arson problems.

The responsibility of the arson report to Congress was with the Office of Planning and Education.

We did submit the report, and I think nationwide we have literally dozens of programs that are under way at the present time to address this crime which we call America's most malignant crime and fastest growing crime.

I think one of the things that might interest you in relationship to this program is that to my knowledge, it is the first time that the Law Enforcement and Assistance Administration has participated actively with the U.S. Fire Administration on any program.

I think, Congressman, you particularly having worked in a municipality recognize there is something less than love between policemen and firefighters. Getting them to cooperate has been one of the major tasks that John Macy and I have been working on. I think it is exemplified in the LEAA granting of $500,000 to us to help implement arson programs.

Its been a very successful operation. It is underway and being evaluated at the moment. In addition to the $500,000 which we have under an intergovernmental agreement with LEAA, another $90,000 has been committed nationwide to the problem of arson.

I think it still probably needs additional funding in some manner, but the program is underway and it is being addressed in a very aggressive manner. As we look at the evaluations, I think that when this organization comes back next year, we will have a real success story to report to you.

These are merely examples because there are literally two or three dozen separate individual programs within the Office of Planning and Education dedicated toward fire education and fire safety. An example of another type of cooperation within the Federal Government, this particular one being with Health, Education, and Welfare, where they must certify for medicare various rest homes and facilities.

We did not have the total skills within the U.S. Fire Administration, but we did under an agreement with HEW which goes to the Center for Fire Research out at National Bureau of Standards. They in turn produced a program and we are now out teaching 100 areas in the United States, instructing and qualifying people so they can actually inspect and certify these particular facilities.

One of the things that I suppose is most helpful for almost any jurisdiction in the United States are the numerous publications that we do produce and mail, not only from the Office of Planning and Education but also from the National Fire Data Center.

And certainly one of the outstanding accomplishments that has occurred during the past year is the National Fire Academy at Emmitsburg. As you recall when we were in here last year, there was substantial controversy over whether we should be in Emmitsburg. There were doubts whether we would ever open. I'd like to bring you up-to-date on something I think was rather significant in the matter of education and training of firefighters nationwide.

The National Fire Academy is open and operating. The Academy is of course broken into two major categories: the resident program, wherein we will be training about 6,000 to 8,000 firefighters, and others who are associated with the firefighters and people who are associated with the firefighting profession or allied professions each year.

I think one of the significant things that is frequently forgotten is that we have placed additional emphasis on the outreach program. In other words, how do we get into the various communities, how do we leverage what we are actually producing out there. Recognizing there are probably about a million and a quarter firefighters in the

United States who need some way besides actual residence programs to reach this vast group of firefighters nationwide, the outreach program where we have placed additional emphasis since I was here last year is obviously the answer to that. Exactly how that will function is not totally finalized, but we do know that we are going to be working through the State training programs in each of the States. We will do some training ourselves in the field where it is needed. The real success story will be told when both of those programs hopefully in less than a year will reach their maximum delivery capability.

I think one of the things there that excites me most is the train-the-trainer concept which would bring a person from anywhere in the United States, instruct them in a teaching methodology and teach them after they have had the educational methodology capability instilled in them. We would then take that individual and send them back to their own community and have them multiply, in other words, a multiplier effect of what they learned at the Academy.

One of the keys to our effectively operating at some reasonable economic level is our ability to leverage other money. Mr. John Macy and I have talked about this frequently, and I'd like to show you just two examples of what I consider rather outstanding cooperation from the private sector. One from an insurance company, another one from the National Fire Protection Association, wherein with very little investment on our part, but a maximum of cooperation, these two groups have helped us produce at minimum cost a product that communities can use nationwide.

And the first one is an example of how the Hartford Insurance Co. with our assistance but primarily on their own produced a media handbook.

The ability to sell a fire program in the community is the ability to tell your story. The handbook was produced entirely with Hartford funds with our technical assistance and will be available to those communities who are interested in installing an effectivd fire prevention program in our community. This is only one example of the Hartford Insurance cooperating with us. Another one which will have a significant effect nationwide immediately and certainly in the long range, is the so-called learn not to burn curriculum. This is a curriculum developed by the National Fire Protection Association. I did a press conference with Chief Andy Casper in San Francisco last Thursday, and the San Francisco School System is installing this curriculum in the entire San Francisco School System.

The National Fire Protection Association (NFPA), was overwhelmed last year with requests when this curriculum was introduced. NFPA did not have the appropriate funding and in some cases other assistance was needed to tell this story nationwide.

We cooperated with them and I think that if we can appropriately teach children the significance of fire prevention and the seriousness of fires that we can have a real impact on the fire problem in America.

These are merely two examples of where we have been able to leverage other groups to assist us in resolving the fire problem.

We feel that based on our finding, we leverage about 7 to 1, and I am rather proud of that. I think that is a good example of some untapped resources that have not been used previously and within FEMA John Macy and I have decided that the same formula that works for the

U.S. Fire Administration can work for other problem areas in emergency management.

I guess if I were sitting where you were about this time I'd say, "OK, Vickery, what have you done for me lately," that is what you did last year and you told us you were going to do that.

So I would just like to list, Mr. Congressman, some things that I think have happened within this past year, things that are ongoing, things that will grow. I think they are significant items. There are obviously dozens of others, but I think that a number of people throughout the U.S. Fire Administration in FEMA are due a great deal of credit for the National Fire Academy, in purchasing that institution, and opening it in 10 months and graduating students is a rather remarkable achievement. So I guess here I have a chance publicly to praise a lot of people who worked very hard to make that institution work.

It is working and it is just starting. The response from the fire community has just been marvelous. It is working, and I am very proud of what we have been able to do up there with the funding that was provided here just a year ago.

One of the other things that, as you look at new organizations starting, is that the U.S. Fire Administration which is only 5 years old, FEMA less than a year, is the matter of credibility. And as nearly as I can judge and I guess this is bragging a little bit, I think that we have substantially turned around what was a negative attitude in the fire community nationwide.

There are 13 fire service organizations nationwide and literally dozens of other public interest groups. The Fire Administration had its rough years getting started but this past year we have held meetings with the International Association of Fire Fighters, International Society of Fire Service Instructors, and State fire training directors. We are going to meet with the National Fire Protection Association week after next. We have met with the volunteer groups for the first time, and had a week with them.

I don't know of any group within the fire service that we have not sat down with in the past year listened to their feelings about the U.S. Fire Administration, and about FEMA and encourage them to give us not only their suggestions, but their criticism. I feel strongly that we have established within the fire community the credibility of this organization.

You have to have that to successfully function, and I am proud of us being able to have done that in the past year. I think that where there was a great division of opinion, and attitudes between the rural firefighting group and the municipals that we have been able to meld and see them work cohesively as a team.

I have listed four major initiatives for a 2-or 3-year period, and I think each of them are significant and I think each of them will impact not only fire but life safety nationwide. One of those initiatives that particularly applies, I think not only to the Fire Administration but to FEMA, is the matter of emergency medical service.

A lot of fire chiefs nationwide still get indigestion when they think of emergency medical service as a part of the fire team, and I just don't share that opinion. I think that any jurisdiction has a substantial capital investment in its fire department, and that to use that fire department to the fullest extent, is the objective that we have at the U.S. Fire Administration.

I talked to Howie McClennan, the president of the International Association of Fire Fighters. Howard McClennan shares with me, that productivity is the major responsibility, not only of management, but of the unions. I offer EMS as not only a chance for a fire department to serve its community better as one of the great untapped resources in America, but provides the ability to more productively use what is a substantial investment in the fire department.

About 50 percent of your municipal budget in the municipality goes for police and fire. That means that about 25 percent of that goes for fire, and I think that this is an example for FEMA and the U.S. Fire Administration to prove to the Nation that we have a tool, a resource, that has not been used fully.

Another one that really gives fire chiefs indigestion and I feel we are sort of out in the forefront of pushing this particular concept, that is the matter of women in the fire service. It is controversial. I think that they have not only a legal right to serve, I think we have again an untapped resource in America that has been by various attitudes and means kept from serving properly. We held a meeting in August of last year. As a result, we will be publishing a document on that very shortly. As an opportunity unfolded for discussion much of the opposition has melted. I think that you will find within the fire service a continued growth of women serving in the fire service.

My concern is that the fire service not find itself in the posture that it did 10 or 12 years ago when minorities first came into the fire service and we had a tendency to react. I would prefer that FEMA and the U.S. Fire Administration come up with programs and identify them ahead of the problem. Thereby helping guide and choosing the standards and the selection methods that would be used.

I have mentioned to you very briefly one of the other major initiatives, and that is the matter of arson and the addressing of the arson problem. I won't go into that in detail, but only to say that we have dedicated certainly a significant amount of our effort and the Federal Government has committed a significant amount of dollars to proving to local communities they can make programs work.

Again, it is a local problem and it has a local solution. We have been able on the Federal level to prove to communities nationwide that if they will pool their resources using a task force concept of addressing a problem, that it will work and you can have a significant impact on the arson problem.

One that we are working very closely with the other components within FEMA is hazardous materials incidents.

There are numerous Federal programs not totally coordinated. John Macy has dedicated himself along with the U.S. Fire Administration to serving one of the fundamental roles of FEMA—coordination of the Federal effort.

We have had a study under way for a month within FEMA addressing this specific problem, and obviously our interest and concern in the U.S. Fire Administration is that the fire service, fire departments are always, or almost always the first responders to an incident.

A lot of other forces come into being later, but the initial group or the initial command that is established on almost every incident is the fire service. We have not had adequate training. We have not appropriately trained in the sense of command structure. There are a couple of States that are doing some training and some good programs.

Generally, nationwide we have done a poor job of using even the available resources so there is a significant initiative that is underway at the present time.

I went to John Macy when I finished my term as Acting Director and he became Director of the Federal Emergency Management Agency and indicated to him that I felt it was impossible for the U.S. Fire Administration to relate properly with 50 States working from 2400 M Street, Northwest, here in Washington. We just simply did not have anyone out in the field who either had the sensitivity to report to us, the success or lack of programs who could assist people out in the Federal regions in the whole range of activities relating to fire, in which we did not have the output available in the field.

My recommendation was that we establish in each of the 10 Federal regions a fire representative who would have the responsibility for relating to our programs here in Washington, who would serve as a listening post in the region and who could be of assistance to those groups in the region that needed assistance. I am happy to report to you that in the next 30 days we will be choosing the people that will serve in the 10 Federal regions. I have just finished meeting with Denver, San Francisco, and Seattle, regarding that specific part of our program. I not only found enthusiasm, but a great feeling of need on the parts of those people in the field.

We continue to exert effort within the U.S. Fire Administration on prevention as opposed to suppression.

And this, again, is always a sensitive subject, most firefighters would prefer to fight fires rather than performing inspection duties. I think it is a changing attitude. If we are ever going to significantly change the fire picture in America, it is going to occur through management changes and prevention.

There are really not very many areas that have a first class fire prevention program.

Mr. Chairman, that completes my generalized explanation.

I do have some of our program leaders if you want to look at some specifics a little more detailed.

John Macy, of course, is here, whatever your wishes might be.

[The complete prepared statement of Mr. Gordon Vickery is as follows:]

# STATEMENT OF GORDON VICKERY
# ADMINISTRATOR, U. S. FIRE ADMINISTRATION,
# FEDERAL EMERGENCY MANAGEMENT AGENCY
# BEFORE THE
# SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY,
# U. S. HOUSE OF REPRESENTATIVES
# FEBRUARY 26, 1980

Mr. Chairman and Members of the Committee, I am pleased to appear before you to review progress to date under the Federal Fire Prevention and Control Act of 1974 and to support the extension of authorization for appropriations under that Act for Fiscal Years 1981 and 1982.

We continue to have a serious fire problem in America. Fire causes more loss of life and property than all natural disasters combined. Our latest data shows that fire causes 8,400 deaths a year, another 300,000 injuries and a direct dollar loss of almost five billion dollars.

The bulk of the fire problem in the United States can be characterized as a lot of fires each causing limited damage. Once summoned, fire departments do a good job of controlling the fires. Loss per fire is below that of most industrialized nations. The problem is that so many fires occur -- over 2.6 million destructive fires are attended by fire departments each year. When the losses from these fires are added, it confirms our national fire problem is one of the most serious in the industrialized world. Twenty times more deaths are caused by fire than by floods, hurricanes, and tornadoes combined.

Our homes, the clothes we wear, the chairs we sit in and the buildings we work in all can burn. Residential fires are the main killer. About three-quarters of all fire deaths occur in residences, mostly in ones and twos in the victims' own homes, most often at night.

Arson is a major national blight. It is destroying whole sections of many of our cities. It is one the fastest growing major crimes in America.

In terms of dollars, life loss, and frequency of fires the fire problem is characterized as:

Arson - most costly in terms of dollars;

Smoking - source of fire ignition causing most deaths; and

Heating related fires - most frequent cause of fire incidents in structures.

What are the major causes of residential fire? For fires of known origin in the 15 states for which we have a full year's data, seven cause categories predominate. They are: heating, cooking, incendiary/suspicious, smoking, electrical distribution, appliances, and children playing.

We clearly need to do a better job of preventing fires. The use of information on the fire problem, emerging today at all levels, Federal, state and local, provides the opportunity to target fire protection onto the worst parts of our fire problem. This way, hopefully, the increasingly limited resources available for fire protection at all levels of government can be put to the best use.

Our concentration in the 1980's will be to provide a Federal focus for solutions to America's fire problem and the major issues surrounding it. These are:

- the need to educate the public on their role in fire loss reduction;
- the need to increase the installation of fire warning systems and built-in protection;
- the need to remove fire hazards;

- the need to protect firefighters from death, injury, and disabling disease;
- the need for improved education and training for the nation's firefighters;
- the need to prepare for tomorrow's fires -- highrise fires and hazardous materials emergencies;
- the need to conquer arson;
- the need to help rural fire departments protect the dispersed populations they serve;
- the need for a uniform, broad-based pool of data with which to identify each community's fire problem;
- the need to establish and promote national levels of professionalism among the fire service;
- the need for comprehensive fire prevention and control planning at all levels of government;
- the need to improve the capacity of State and local governments through financial and technical assistance, to deliver effective fire protection;
- the need for a better basic understanding of fire and its effects; and
- the need to provide a focus for the Federal fire community.

Fire prevention and control is primarily a local problem. The U.S. Fire Administration's most important role is to support and reinforce State and local efforts.

Since the agency began, intensive work has been conducted to identify the priority needs on the State and local levels; develop new and improved fire prevention and control techniques; test those techniques; and provide leadership, incentives and methods of getting those techniques into use at State and local levels.

The USFA's emphasis in the area of fire research is to identify, refine and transfer technologies that can have an impact on fire safety, for civilians and firefighters, concentrating particularly on the kinds of fires that cause the biggest parts of the problems. The R&D undertaken is that which has high commonality for departments across the Nation, and is too large for individual departments to undertake on their own.

To carry out this work, the U.S. Fire Administration has three program areas: the Office of Planning and Education, the National Fire Data Center, and the National Academy for Fire Prevention and Control. The programs of the Center for Fire Research (CFR), National Bureau of Standards, are linked to those of the U.S. Fire Administraiton. Since resolving the issues surrounding fire requires a broad-based attack, the USFA confronts this task as an interdisciplinary team, with each unit contributing its unique expertise.

## ASSISTANCE TO STATE AND LOCAL GOVERNMENTS

The U.S. Fire Administration cannot act alone to reduce America's fire losses. Nor have States and communities been able to effectively solve their fire problems individually. Through a cooperative effort involving Federal stimulus of State and local efforts a better understanding of local fire problems, improved targeting of fire protection, and a reduction of fire losses can be achieved.

Since 1977, the Administration has targeted several assistance programs at States, benefitting local governments as well. Helping States build their capacity to develop and deliver programs has been a major Administration-wide objective.

Three coordinated "grants-to-States" programs have been implemented by the USFA:

- PEAP - Public Education Assistance Program;
- NFIRS - National Fire Incident Reporting System; and
- APAP - Academy Planning Assistance Program.

Local fire personnel, nearly a million strong, are recognized as the primary manpower for preventing fires and reducing fire loss. These grants-to-States programs are intended to assist and reinforce the efforts of local fire personnel via their State level fire protection agencies.

Public Education Assistance Program

The experience of the Administration's Office of Planning and Education has been that local public education programs can result in dramatic, measurable impacts on fire loss. To assist States in establishing and expanding their public education efforts, we designed the Public Education Assistance Program, or PEAP. Initiated in 1977, PEAP is a two-phase grants program. Phase I lasts for one year, while Phase II is two years long.

During Phase I a State develops a plan of how a public fire education program will be organized and maintained in the State. To receive a planning grant under Phase I a State agency or institution, such as State Fire Marshal's office or a university, must demonstrate widespread support for the activity among fire sevice organizations in the State, and must involve these organizations in planning. While PEAP plans differ from State to State depending on local needs and circumstances, each State must include administration, resource system development, and technical assistance components in its proposed effort.

Federal assistance in Phase I includes funding of up to $5,000 for partial reimbursement of planning costs. The funds may be used for expenses to train and involve local fire educators in fire education planning and the design and reproduction of fire education materials.

After completion of Phase I planning, a state becomes eligible for Phase II assistance. In Phase IIa, the first year of this two-year phase, the State actually implements a public education assistance program and collects data necessary for program evaluation and improvement. In Phase IIb, the State completes program implementation and uses data from the first year to assess program effectiveness and make modifications and improvements.

Activities are organized into the three components. The administration component is responsible for establishing public fire education as an intergral part of the State fire structure. The resource system development component builds the State's capacity to provide local communities with access to public fire education programs and information through developing resource centers, catalogs, newsletters, or other communications devices. The technical assistance component provides the training and technical assistance necessary to teach local fire educators to use available resources in planning or identifying, implementing, and evaluating public fire education programs that result in decreased fire loss.

Federal assistance in Phase II includes resource materials, a workshop on systematic planning for fire service leaders, and technical assistance in resource development and evaluation. PEAP also provides Phase II funding of up to $15,000 per year for the partial reimbursement of implementation and evaluation costs.

In the fall of 1979, six States were in Phase I of PEAP, five States in the first year of Phase II, and four States were nearing completion of Phase II. The success of the program will be reflected in the degree to which PEAP activities become an ongoing part of State fire public education programs. Indications to date are positive. Based on documentation from PEAP States, we estimate that States are investing at least four dollars in PEAP for every dollar received. This funding ratio reflects a substantial State commitment to PEAP goals. Using a relatively small amount of seed money, PEAP has significantly impacted local public education practices.

### National Fire Incident Reporting System

The U. S. Fire Administration, from its inception, has tried to use existing data sources to the maximum extent possible. For example, in making national estimates of fire deaths, we rely heavily on the HEW Center for Health Statistics' data collected from death certificates. We also use data from private sector sources, such as the National Fire Protection Association's annual survey of fire departments. But these sources do not include adequate information on the cause of fires, nor provide other necessary levels of detail on the fire problem.

We need a "core" of key data on individual fires collected in a standardized, accurate way from around the country. Consequently, the USFA's National Fire Data Center initiated the National Fire Incident Reporting System (NFIRS).

The National Fire Incident Reporting System collects the data needed to make national estimates and it also provides State and local governments with a means of collecting and analyzing data for themselves. Rather than create yet another "national standard," we decided to use a common language, the Uniform Fire Coding System, developed by a consensus standards committee of the National Fire Protection Association. We serve as an active member of the committee, working to further improve the data coding system and extend its use in new fire protection areas such as emergency medical service and hazardous materials.

In those communities participating in the NFIRS system, firefighters record for each fire the type of occupancy, probable cause, number and type of casualties, and a rich array of additional information. The local departments send their data to the State, usually the State Fire Marshal's office. The State processes the data by computer and returns feedback reports to the local fire departments. Every three months the State sends the Data Center a computer tape with their incidents and casualties on it. We use this data to build our national fire incident data base. This base, along with data from other sources, is used to prepare our annual national estimates of the U.S. fire problem. We use this data base on a daily basis for many special reports, often at the request of Congress, other Federal agencies, industry, the fire service, local government, the press and media, and others.

NFIRS is now operational in 20 States and under development in 14 other and the District of Columbia. States participate voluntarily.

Eventually, we would like to have all States and territories in the system. While only a representative sample of communities is needed for making general national estimates, more detailed questions about specific types of fires require a more comprehensive set of data; and, perhaps most importantly, we want to give each State, local government, and territory the opportunity to develop a data system that will allow it to better analyze its own local fire problems and to compare itself to others. Also, we can provide information to Congressmen on their district's problem if their districts are participating.

To States willing to participate in the National Fire Incident Reporting System, we offer the opportunity to apply for a small start-up grant (up to $25,000) and a small second-year grant (averaging $15,000). These amounts typically cover only a small fraction of State costs. We also provide model forms for collecting data; computer software for processing the data at the State level and for giving local departments feedback reports on their own problems; and technical advice on setting up and running the system, and on analyzing the data from it. We also offer to install and test the software in each State and help troubleshoot any computer problems. In addition, the National Fire Academy conducts courses to train users in each participating State on how to collect and analyze fire incident and casualty data. Student handbooks containing instruction on data collection are provided to States joining NFIRS, as well as a newsletter and instructional materials on how fire data is being and can be used locally to plan, manage, and evaluate fire department activities.

We have helped the States in the National Fire Incident Reporting System to organize themselves into a "users" group, not unlike similar users groups organized by computer manufacturers. The State program managers and data processing experts meet at least once a year to exchange information on how to overcome problems and how to cut costs, and to discuss improvements in the system they would like us to make. The State representatives have formed a steering committee to plan these meetings, and the States share the costs with USFA. As new States join the system, they are taken under the wing of States already in the system. We are also trying to promote communication between neighboring States, and within a State between fire departments so that they can help each other on a more frequent, informal basis. The

The users' meetings have been a considerable success in the eyes of the State attendees. The States have begun vying among themselves for the privelege of hosting future meetings. From our perspective, NFIRS has been a rewarding example of Federal-State-local cooperation.

For local governments in States not yet participating in NFIRS, the Data Center offers the NFIRS computer software and training materials, and whatever technical advice we can afford to provide. Some States and many cities choose to obtain the materials and computer programs without applying for a grant.

There are still problems in propagating the system to all fifty of States, in improving the validity of the data being collected, and in providing technical help to the State and local governments in developing their own systems to an acceptable level. But, for the first time, there now exists a way to add data from a number of different States, because NFIRS provides common variables. The NFIRS not only provides the means for making national estimates, but more importantly, provides a management tool for local and State officials by which they can assess their own circumstances and manage their own programs.

Academy Planning Assistance Program

Assisting States to develop a systematic educational delivery system is the goal of APAP -- the Academy Planning Assistance Program. This system in each State will also become a vital part of the National Fire Academy's "outreach effort."

APAP focuses on fire education and training programs through a two-part grant program. The "organizational design" phase supports State identification and analysis of existing State and local agencies, institutions and organizations able to deliver fire protection training and education. In addition, States select the responsible entity for planning statewide fire service education and training.

In the second phase of APAP, the Administration supports a State's effort to develop a comprehensive Five-Year Plan for fire education and training.

Thus far, APAP grants have been issued to 37 States. The Administration expects to continue the APAP program until all interested States and territories have developed their Five-Year Plans for fire education and training.

## RESIDENTIAL FIRE SAFETY

Americans who die from fire most often succumb in their own homes. Most fatal residential fires claim only one or two lives, causing only momentary local interest. Tragic fires like the Beverly Hills Supper Club fire, prison fires, nursing home fires, and hotel fires receive widespread notoriety. Yet, these and other major fires do not represent this nation's major fire problem: the residential fire.

Reducing fire losses in American homes is a major undertaking of the U. S. Fire Administration and involves efforts in several program areas, including the National Bureau of Standard's Center for Fire Research. Education programs are in progress to make Americans more conscious of fire, and research and development projects are under way to make America's homes safer.

For the past three years, the USFA concentrated on reducing fire losses through public fire education programs. Two such programs -- smoke detectors and home safety surveys -- are aimed at reducing fire hazards and fire losses.

## Smoke Detectors

Smoke detectors are one of the most significant technological devices available to reduce fire loss in American homes. Our National Fire Data Center has found that for fires occurring during normal sleeping hours (11 p.m. - 6 a.m.), fires in single-family homes without detectors are two and one-half times more deadly than fires in homes with a detector; and there are one and one-half times more fire injuries in homes without detectors than in those homes with detectors. The National Fire Data Center is conducting major programs on residential fire detection and suppression devices. From June 1976 to April 1979, researchers investigated 117 fatal residential fires, in which there were a total of 171 deaths and 182 injuries. After detailed analysis, they concluded that 86% of the deaths, and 86% of the injuries, and 68% of the property losses might have been prevented by the proper use of residential detectors, provided the equipment worked properly and all occupants took proper action. Astounding potential results for such a minor investment. The Office of Planning and Education has monitored 2 smoke detector community action programs.

With the growth of competitively-priced smoke detectors came demands from the public and fire service for up-to-date information on types of detectors, installation and maintenance. From State and community governments came demands for information on legislation which could make smoke detector installation mandatory. To answer these needs, the Office of Planning and Education has carried out several initiatives during the past three years. These programs aim to increase awareness of the effectiveness of smoke detectors in reducing loss of life from residential fires; encourage residents to purchase smoke detectors; and instruct them about the correct placement and maintenance of these devices.

Public awareness campaigns have included the release of a general fact sheet, "Smoke Detectors Save Lives," a pamphlet, "Wake Up! Smoke Detectors Can Save Your Life If . . ." During 1977, OPE distributed more than 69,000 copies of these publications, primarily to private citizens. Since then, more than 300 local organizations have requested negatives to "Wake Up!" for local reprinting. As a public service, Sears, Roebuck & Company distributed more than 4.1 million additional copies through 121 local fire departments. Also, the Hartford Insurance Group distributed approximately 175,000 copies through its independent insurance agents. In total, the brochures have reached an estimated 5 million Americans.

To help local fire departments educate their communities about smoke detectors, OPE coordinated development and publication of a five-volume series of smoke-detector manuals during 1977. Each unit of USFA contributed to the content. One of the manuals, Smoke Detector Resource Catalog, was mailed to nearly 30,000 fire departments. The other manuals are Smoke Detectors: Moving the Public; Smoke Detector Technology; Smoke Detectors and Legislation; and Smoke Detector Training; approximately 10,000 of each have been distributed. The Smoke Detector Legislation manual was updated by the Nationa Fire Data Center this past year.

These manuals are now available upon request to fire personnel. They were used initially to train State and local fire educators who then teach both other fire service personnel and the public about smoke detectors. From September 1977 to June 1978, 9,367 fire personnel partcipated in 93 three-hour smoke detector seminars conducted by OPE throughout the country. All participants received the Smoke Detector Technology and Smoke Detectors Training manuals.

OPE contracted with the American Institutes for Research (AIR) to conduct a study of the impact of these seminars. Through a random sampling of conference participants, AIR determined that a statistically weighted average of 175 persons was trained by each seminar participant. Thus, the 9,367 individuals who attended the seminars are estimated to have trained more than 1.6 million individuals in the use, installation, and maintenance of smoke detectors. About 300,000 of these 1.6 million were fire service personnel, while approximately 1.3 million were citizens at large.

The Fire Administration's technology development program managed by the National Fire Data Center, has been working with the detector industry through small seed grants to advance the development of more reliable detectors and extend their use into automatic residential remote alarm systems (ARRAS), where whole communities are "wired in" to the fire department's call center. Materials on detector effectiveness and new technology are being provided to local communities and State agencies working to enact ordinances that require detectors in homes and on ARRAS systems to developers and communities interested in these more advanced systems.

### Residential Safety Surveys

Fire departments in about 55 cities in 25 States are now surveying homes to identify and correct fire hazards as a result of OPE efforts. These surveys are designed to eliminate hazards in the home and thus reduce fire risk and incidents. The surveys are conducted using senior citizen and CETA (Comprehensive Employment and Training Act) personnel as community fire educators.

This nationwide effort owes it beginnings to an 80-hour training package developed by the Edmonds, Washington, Fire Department with a $35,000 grant from OPE. The training program prepares individuals to carry out a house-to-house fire education/residential survey campaign.

In Edmonds, a community of 25,000 people, three trained teams of two persons each conducted home inspections. As a result, residential fires in Edmonds dropped a dramatic 84 percent in three years. This impressive loss reduction prompted OPE staff to consider ways of making the program available to other communities. A major obstacle to widespread use was lack of community resources to hire residential inspectors. Thus the OPE staff began by researching possible sources of Federal support, an effort that led them to Title IX (now Title V) of the Older Americans Act. Funded through the U.S. Department of Labor (DOL), Title V supports more than 50,000 senior citizens who work 20-25 hours a week in a wide range of social service tasks. Funds are allocated to program sponsors including State agencies, then are funneled to regions and local jurisdictions.

Through contact with the Department of Labor Employment Training Administration, OPE staff gained introduction to four program sponsors that administer Title V grants from contract DOL: National Council on the Aging; National Council of Senior Citizens: American Association of Retired Persons/National Retired Teachers Association; and National Farmers Union Green Thumb Program.

OPE staff held a meeting with representatives of these organizations to convince them that fire education is a worthwhile task for senior citizens. In October 1977, OPE and the National Council of Aging sponsored a pilot training session for senior home surveyors in Huntington, West Virginia. Subsequent to this successful effort, all four major contractors have worked with OPE staff to inform local sponsors of this potential new task for senior citizens. As a consequence, 37 communities as diverse as Tucson, Arizona; Gulfport, Mississippi; and Memphis, Tennessee are tapping this new resource to take their fire education message to the public.

In addition, 17 other communities are employing Federally funded CETA workers as residential inspectors; another is using volunteers. While some communities report positive CETA experiences, others cite some disadvantages including excessive red tape, a relatively brief funding period to train and utilize staff, and exclusion from the personnel selection process. In 1979, 40 cities had programs with Title V funds.

In most instances, both with CETA personnel and senior citizens, the salaries of inspectors are paid using Federal monies. However, the local fire department generally supplies the 80 hours of training and purchases the training materials at cost through the Edmonds Fire Department.

### Built-in Fire Safety for Homes

Making American homes more fire safe is not an easy task. The USFA has several technical studies in progress through the National Fire Data Center (NFDC) and CFR. The goal: increased, affordable fire safety in the American home.

Smoke detectors were studied under a contract with USFA by the Aerospace Corporation. The objectives of the study included: identifying manufacturers of residential detectors and noting characteristics of currently available models; estimating current and future sales markets; and, determining the level of consumer awareness and acceptance. The study indicated that 33 million detectors were in place as of May 1977, in 17 million American homes. This survey was updated in January, 1980; we are awaiting results of the analysis to see how the situation has changed.

Home fire suppression systems, particularly those with a remote alarm to alert both the fire department and the occupants, offer major advantages. The fire can be contained more readily in its room of origin, limiting damage and making firefighting "safer" through earlier alert.

Coordinated series of six major suppression-related studies have been conducted by public and private organizations under USFA grants. Based on these studies, the USFA concluded that it is possible to design an effective, affordable fire sprinkler system for homes.

One of the studies, conducted by the Johns Hopkins University/Applied Physics Laboratory, assessed the potential impact of fire protection systems.

Factory Mutual Research Corporation reported on a performance standard for low-cost residential sprinkler systems. Based on this and other studies, the National Fire Protection Association, Sprinkler Committee is now working with us to revise its residential sprinkler standard.

Sprinkler systems were also studied by CFR. Tests were conducted to study their performance and the use of light-duty support systems for sprinkler piping. Tests were also completed on the performance of sprinklers in health care facilities.

Smoke detectors were also studied by CFR, including the development of performance test methods, siting criteria, and the work which led to the Underwriters Laboratories' adoption of a new smoke detector performance standard, and changes to the NFPA standard for installation of smoke detectors in homes.

In another important home safety area the Data Center compiled statistics that showed that the combination of residential furnishings and smoking materials account for 1500 fire deaths per year or 23% of all fire deaths in residential structures. Written testimony on this hazard has been submitted to the CPSC by USFA and analyses of existing data have been supplied to Congressional offices as well as private sector organizations on this matter. A proposed cigarette ignition test for upholstered furniture, developed by CFR for the Consumer Product Safety Commission, has been submitted to the

NFPA for review and adoption. As a result of this activity, a voluntary standard developed by the Upholstered Furniture Action Council (UFAC) has been accepted by the Consumer Product Safety Commission on a trial basis for a period of one year.

In other efforts to make American homes safe, CFR studied the flammability of insulation used in remodeling attics, walls, and basements. Two new test methods were developed and submitted to GSA. They are the basis for a CPSC standard in this area. Fire growth in rooms, the role of furnishings in room fire development, and the fire endurance levels of basement ceiling construction and interior finishes of mobile homes were also investigated.

Some of our other recent accomplishments, work currently being done or planned in the Residential Fire Safety area are briefly described as follows:

Office of Planning and Education

- o A media package on cooking fires was developed in 1979 and is being field tested.
- o A manual and workshop on Evaluating Home Safety Survey Programs was developed in 1979, and will be field tested in 1980.
- o A rural module for the Edmonds Home Safety Survey Program will be developed and field tested in 1980.

National Fire Data Center

- o Further testing and development for establishing a new standard for residential sprinkler performance continues.
- o A draft report on mobile-home fire problems was submitted to HUD in 1979. Five hundred investigations were completed. Final report supporting the effectiveness of the 1976 HUD Mobile Home Standard for Fire Safety in in final draft.

- The positive results of smoke detector tests conducted in actual fires in Los Angeles are about to be published.
- The International Association of Fire Chiefs report on effectiveness of smoke detectors in actual fires will be published in 1980.
- The Schirmer/ADT report on the Automatic Residential Remote Alarm System and the Woodlands, Texas report on the effectivness of a remote alarm system were completed in 1979.
- In 1979, the first batch of thermal-insulation fire investigations was delivered to HUD. Ten cities now have investigators trained in these investigations. The final report on thermal-insulation fires will be submitted in FY-80.
- In 1979, reports were completed by the Illinois Institute of Technology Research Institute on:
  - New Methods of Testing Smoke Detectors
  - Cost-Benefit Analysis of Fire Detectors
  - New Detector Concepts
- Factory Mutual Reports on Improved Sensitivity of Fusible Links, and Requirements for Residential Sprinklers were completed in 1979.
- A report was completed regarding tradeoffs between automatic sprinklers vs. building codes (Council of Residential Building Officials).
- A survey of households with smoke detectors is being conducted and will be completed in 1980.
- A report on the success of extensive sprinklering in public buildings in Fresno, California will be published.

- To promote legislation and local ordinances requiring smoke detectors in residential properties, State legislatures and city governments are being provided our new Smoke Detector Legislation Update Report and new Data Center findings on the effectiveness of detectors in reducing casualties.
- In 1980 the Data Center began supplying detailed analyses of fires and fire loss to the appliances manufacturing industry, the plastics industry, the textile industry, and the forest products industry both through their trade associations and to individual firms to make them aware of the potential fire hazards presented by their products and to suggest R&D aimed at the development of safety products.

National Fire Academy

- The curriculum development of a course for Smoke Detector Training was completed and the course delivered as part of the four two-week field programs in 1979.

Center for Fire Research

- Final recommendations were made to HUD in 1979, for upgrading their fire-safety requirements for mobile homes.
- A reduced-scale model mobile-home fire test will be developed for HUD in 1980.
- A new test for the fire resistance of residential construction will be developed in 1980.
- A mandatory standard for insulation was promulgated by the Consumer Product Safety Commission in 1979. This incorporated new flame spread and smoldering tests developed by CFR.

- In 1979, the cigarette test for ignitability of upholstered furniture was introduced to NFPA and ASTM for adoption as a voluntary standard. As a result of this activity the Consumer Product Safety Commission provisionally suggested a voluntary standard developed by the Upholstered Furniture Action Council for a period of one year.
- The effectiveness of self-extinguishing cigarettes in reducing upholstered furniture ignitions will be determined in 1980.
- A report and manual for the assessment of the electronic reliability of smoke detectors was published in 1979.
- A portable aerosol generator for the measurement of the sensitivity of smoke detectors was demonstrated and the design was made available to commercial suppliers in 1979.
- A preliminary evaluation of the potential effectiveness of alternative approaches to residential fire safety will be completed in 1980.
- A new test to evaluate the flame-spread potential of furnishings will be developed in 1980.
- A method for identifying unusually toxic-burning materials will be completed in 1980.
- Toxic-threat scenarios will be selected and studied in large-scale experiments in order to relate laboratory-test results to real fire conditions.
- Studies will be continued on the audibility requirements for home fire alarms in 1980.
- A study of the response of occupants to wakening by home fire alarms was initiated in 1979 and is continuing.

- o A report on the safe installation and operation of wood-burning heating devices will be published in 1980.
- o An ignition-test method for interior-finished materials will be submitted to ATM.
- o A draft of a fire-safety evaluation system for group homes for the developmentally disabled will be prepared and field tests will be initiated in 1980.
- o A preliminary assessment of a fire-safety evaluation system for multi-family dwellings will be made in 1980.

We can provide additional information on any these projects, if desired.

Some additional areas and undertakings I envision for the Residential Fire Safety area in 1981 and 1982 are briefly described as follows:

Office of Planning and Education

- o Expand the Public Education Assistance Program to include three additional States.
- o Continue assisting in the dissemination of the "Learn Not to Burn" curriculum developed by the National Fire Protection Association.
- o Promote marketplace acceptance of sprinklers for new homes by studying the product acceptance problems and developing an education campaign for the public and the home building industry.

National Fire Data Center

- o Continue the promotion of smoke detectors with documentation of effectiveness, improved technology to increase reliability, and the consideration of tax and insurance incentives.

- To have an even greater impact on fire loss reduction the home sprinkler system will be adapted to retrofit existing homes of which there are an estimated 70 to 80 million in the United States. Performance requirements for a retrofit system will be established, candidate designs will be identified and tested, and solutions to installation problems such as hook-up restrictions and back-flow will be identified and resolved.
- Similar but more limited work will be undertaken in 1981 to evaluate the effectiveness of residential remote fire alarm systems which are currently being installed in new home developments in various parts of the country.

National Fire Academy

- Training courses to acquaint firefighters with the fire prevention aspects of residential properties will be offered.
- The professional capabilities of those fire service personnel responsible for fire inspections will be improved through Academy programs.
- We will train firefighters in the development and delivery of educational programs to increase public awareness to the fire problem.

Center for Fire Research

- By 1985, a home fire safety design manual will be published.
- Performance criteria for home heating, ventilating, and air-conditioning systems and other sub-systems useful in residential fire safety will be published and recommendations to NFPA standards committee and other appropriate agencies will be submitted.

## Firefighter Safety & Health

Firefighting is one of America's most hazardous professions. The statistics are grim:

- Half of all reported injuries from fires attended by the fire service are suffered by firefighters.
- In a study of 101 line-of-duty firefighter deaths, 45 were caused by heart attacks, three times the rate of the second largest cause of death.

The hazards of other occupations, such as mining and police work, receive far more public attention than those threatening firefighters but they are no more hazardous. Increased occupational safety for firefighters is urgently needed, both for the protection of the firefighters themselves and for increased firefighting effectiveness.

To better protect America's firefighters, the USFA is conducting programs designed to provide better protective clothing and equipment and to improve the physical fitness of firefighters.

Americans may think firefighters are well protected when they enter a burning building. All too often they are not. Their clothing is not as resistant to fire as it should be: some helmets actually melt and some turnout coats and pants can melt and burn. The weight and bulkiness of firefighters' clothing and equipment can severely limit mobility and contribute to the strain on the firefighter, whose body is already working under the most severe of environments. The physical and emotional stress of the job can as much as double a firefighter's heart rate.

A major program was started with the National Aeronautics and Space Administration (NASA), called Project FIRES (Firefighters' Integrated Response Equipment System), for the design and development of an integrated protective system or "envelope." The thrust of the program is to use modern technology, some of which is the result of NASA's space technology, in a systems approach for providing improved clothing and equipment for firefighters. This cohesive approach contracts sharply with the "piecemeal" approach of the past.

Understanding the fire environment within which a firefighter works is critical to establishing a protective envelope. To understand the occupational hazards of firefighting, USFA sponsored a study which resulted in the report "The Thermal Environment During Structural Fires." This study provided an onsite appraisal of the thermal exposure firefighters face. The results, that firefighters endure mostly radiant heat, not convective, will be used in designing improved protective equipment. These findings have now been incorporated into the plans for Project FIRES protective envelope.

In another project, the air contaminants of actual structural fires were sampled and measured. Knowing the toxic contaminants in the fire environment will help define the respiratory protection requirements of the firefighters' protective envelope, as well as contribute data on fire's deadly effects. Prompted by this project, the Boston Fire Department began requiring its firefighters to wear their air masks at all structural fires. Respiratory injuries were reduced by 80 per cent during the first year this mandatory mask rule was in effect.

Firefighting is strenuous work, requiring above average strength and endurance. Heart attacks cause a high percentage of firefighter line-of duty deaths. To meet their job demands and guard agains heart disease, firefighters must be physically fit.

The Administration's work in the area of firefighter physical fitness is presented in two published reports: "Development of a Job-Related Physical Performance Examination for Firefighters" highlights results of the first study to measure in detail the physiological effects of firefighting on the heart, lungs, and muscles. The report concludes that the successful completion of firefighting tasks requires a physical performance profile "reflecting youth," and that two-thirds of the firefighters studied did not meet this profile. The study was conducted by the University of Maryland under a grant from the USFA.

Regular exercise can be the most effective method for remaining fit. More than 1,000 fire departments responded to a study conducted by the International Association of Fire Chiefs Foundation for the USFA's Data Center to identify fire departments with ongoing physical fitness programs and to recommend which types of programs seem to succeed. Only 18% reported some type of active physical fitenss program. Another 11% reported they had discontinued their physical fitness programs. The study results, published as "Fire Service Physical Fitness Programs," concluded that the fire service must begin to upgrade its in-service physical fitness training, and offers suggestions on how to do so. Results have also been furnished to the Office of Personnel Management for guidance in dealing with the approximately 29,000 Federal firefighters.

Some of our other recent accomplishments and work currently being done in the area of Firefighter Safety and Health are briefly described as follows:

Office of Planning and Education

- A firefighter burn prevention program was initiated in conjunction with the Internation Association fo Fire Fighters.

National Fire Data Center

- Performance standards and the design prototype for the Firefighters Integrated Response Equipment System (Project FIRES) was completed in 1979. Through grants to selected fire departments across the country field tests and evaluation of the firefighter protective ensemble developed under Project FIRES will be conducted in 1980.
- A comprehensive reporting form for collecting data on firefighter injuries and occupational illnesses was tested and revised by October 1979. An indepth report on firefighter injuries and occupational illnesses will be completed in 1980.
- A manual on the use and maintenance of breathing apparatus is being prepared.
- Physical fitness programs of both paid and volunteer departments are being surveyed to find out what works.
- A study is starting on the longer-term occupational diseases of firefighters, continuing the research on the toxic environment of structural fires.
- A survey of communities across the country is just getting underway to determine the dollar costs experienced due to firefighter injuries, illnesses, and deaths.

National Fire Academy

- Four field programs, two of which included management of a fire service physical fitness program, were conducted in 1979.
- Curriculum development of a course for operational risk analysis was completed and delivered as part of the four two-week field programs in 1979.
- Regular delivery of the management of a fire service physical fitness program course to resident students at the Academy began in January 1980. The course is currently being evaluated.

Some additional areas and undertakings I envision for the Firefighter Safety and Health in 1981 and 1982 are briefly described as follows:

National Fire Data Center

- Pilot-test a firefighter death and injury data system add-on to NFIRS in two states, collect actual data on firefighter duty-caused deaths and injuries from a sample of communities, and publish findings on the major characteristics of firefighter safety and health problems.
- Develop an analytical method fire departments can use to identify their most serious long-term occupational health hazards.
- The field-testing of the firefighter protective clothing outfit, developed during the past three years by USFA initially with NASA and now with the fire equipment industry, will be completed. Determine and publish design and manufacturing specifications and performance standards, which will be incorporated into the voluntary standards used by fire equipment manufacturing firms. A product awareness program for the fire service on the life safety and fire

and firefighting effectiveness value of improved protective clothing will be conducted.

- Based upon performance evaluation, we will develop and promote an improved physical fitness programs for both the paid and volunteer firefighter that will insure that he can perform his duties efficiently and reduce the high incidence of cardiovascular problems and sprains which are among the leading types of injuries to firefighters.
- Identify other effective safety programs in use, where data is available from the fire departments and disseminate information across the fire field so departments can follow the success of others.
- Modify protective garments currently used by industry to protect workers from hazardous materials so that they meet the requirements of municipal firefighters performing rescue, firefighting, and clean-up in hazardous spills; and field-test the garments in several departments by 1982.
- Stimulate industry through small R&D grants and funding of tests to modify the existing closed-circuit breathing apparatus now used for working in dangerous atmospheres in industry into a system that is lighter and lasts longer (1-4 hours), and will operate in the hostile firefighting environment; and will field-test the resulting breathing apparatus in selected departments.
- The health and safety problems unique to women firefighters will be studied to design physical fitness training programs and equipment modifications.

ational Fire Academy

- Development and distribution of a hand-off package on the Utilization of Breathing Apparatus for use at state and local levels;

- Development of courses to increase management and firefighter awareness of personal safety needs of the firefighters, both while engaged in fire suppression or other emergency activities, and while performing non-emergency duties.
- Develop courses to enhance the professional level of firefighters thereby increasing awareness of the duties and dangers of firefighting.

## ARSON

In cities across the Nation, from Seattle to the South Bronx, arson has becme a national epidemic. In one New England city, arson has risen by 300 percent over the past five years and has increased from 16 percent to 46 percent as the cause of fires in that city. The national direct loss due to arson is estimated at $1.3 billion per year, a figure that is comparable to losses due to other major crimes such as larceny-theft ($1.1 billion) or burglary ($1.4 billion). Beyond this, tax losses due to arson could multiply these losses many times.

Based on data from 15 States, incendiary and suspicious fires are the leading cause of property loss in buildings. These fires cause about 15 percent of the known residential dollar loss and almost 25 percent of the known dollar loss in non-residential buildings in those States.

Arson is an issue of broad scope and complexity. The arsonist's motives range from revenge to arson-for-profit. Sometimes arson schemes are designed to stop business losses, to remove low-income tenants, to create new land parcels for construction, to collect over-insurance monies or to go to the head of the new apartment list. Criminal involvement, human behavior, social change, business and economic trends, urban decay -- all contribute to the national arson epidemic.

Arson is a killer. Set fires burn quickly, trapping tenants and endangering firefighters. Over 700 lives are lost each year to arson. In New Jersey, 28 people died as victims of arson fires in a one month period.

The responsibility for stopping arson rests with several agencies. Coordination among firefighters, police prosecutors, insurance and banking representatives, municipal officials, and community groups is critical to solving this problem. Arson is a crime which crosses organizational boundaries and requires broad base countermeasures for solution.

Our recent report to Congress, "Arson, the Federal Role in Arson Prevention and Control," outlines the nature and magnitude of the Nation's arson problem, and makes recommendations which fall into four action areas:

- management of arson program;
- investigation/prosectuion of arson;
- removal of economic incentives to arson; and
- dealing with the psychologically-motivated arsonist.

In the management area, there is a need for Federal assistance to State and local agencies in analyzing their data to identify the types of arson that are occurring in their communities. There is a need for municipal arson early warning systems to predict where arson may occur and permit preventive action. There is a need for public arson education to publicize anti-arson efforts and successful prosecutions to deter would-be arsonists. There is a need for community action in high arson incidence areas, since community organizations can provide a first line monitoring of arson activities.

In the investigation and prosecution area, coordination among firefighters, police, and prosecutors is the key. Where Federal jurisdictions exists Federal prosecution and investigation assistance should be provided where the presence or organized crime or high incidence make it difficult for local authorities to respond to their arson for profit problem. Training is required for firefighters, fire investigators, police officers, prosecutors, and insurance adjusters. Courses on arson detection and investigation should be distributed broadly to fire and police investigators. State and local governments need assistance and laboratory support to identify accelerants and to process criminal evidence.

In the economic area, incentives to arson in laws and policies affecting the insurance, banking, housing and commercial industries must be eliminated. Insurance underwriting and claims procedures must be modified. Fraudulent claims must be contested. Opportunities to abuse Federal and State housing and loan incentive programs in arson-for-profit schemes must be removed. Commercial arson schemes must be detected through monitoring and analysis.

In the behavioral area, communities with juvenile firesetting problems should receive training in the successful methods which have been developed. Prosecutors and fire service personnel must be trained to deal with revenge-motivated fires.

The Center for Fire Research has supported a completed study on the psychological profile of fire setters which will be a primary reference for future efforts in the counseling of arsonists.

Arson is, and will remain, primarily a local problem. The principal role of the Federal Government is to provide assistance to State and local agencies to support their arson prevention and control programs. However, the arson patterns, the criminals' operations, and the magnitude of the problem extend beyond municipal boundaries. Only through a coordinated effort among Federal, State, and local agencies working together with business and the public can arson be reduced.

Arson has been studied to death. Our responsibility now is to act -- coordinated actions which will reduce arson's devastation to our cities and our people.

To develop a coordinated Federal attack on arson, we will work closely with other Federal agencies -- the Law Enforcement Assistance Administration, the Federal Bureau of Investigation, the Department of Housing and Urban Development, and the Treasury Department.

Counseling Juvenile Firesetters

Our Office of Planning and Education has recently produced 2,000 copies of a practical guide for local fire departments to use in dealing with juvenile firesetters in their communities. In addition, a workshop and videotape on the topic have been field tested and are now being used to train fire service personnel.

The materials and workshop are an outgrowth of an education and counseling program developed by the Los Angeles County Fire Department. The program reduced the number of fire incidents involving juveniles from 169 to 12 during a three-year period. There were no repeat offenders. Consequently, in 1977 OPE provided L. A. County with a $10,000 grant to refine and package the program for use by other communities. OPE provided an additional $15,000 in 1978-79 to develop the workshop and a videotape of techniques for counseling juvenile firesetters, and to field test the workshop in four sites throughout the country.

Eight individuals have now been trained to provide workshops for others. In the past months, these individuals have trained more than 1,500 fire service personnel in 20 cities to use the counseling techniques described in the materials. Because of widespread interest and demand, the workshop is now being made available through OPE's Arson Technical

Assistance effort as well as through its Public Education Assistance Program described earlier.

Materials developed to date focus on children under seven years of age. Development of additional materials aimed at juveniles 7-14 years old is currently being planned.

The identification, additional development, and testing of the outstanding L. A. program is part of OPE's overall strategy of identifying and spreading effective techniques for reducing fire incidents. OPE is making this excellent locally-developed program available nationwide.

Arson Prevention Program

OPE is responsible for identifying, developing, and validating materials and strategies for use by State and local agencies in their efforts to prevent and control arson. The development and testing of the materials and workshop on juvenile firesetters is designed to tackle a specific arson problem. In addition, OPE is engaged in several other efforts, including the coordination of all Federal arson prevention and control programs.

In 1978-79 OPE provided grants to six cities and one state to assist them in developing arson information management systems. These efforts generally begin by identifying factors that differentiate between buildings that burn due to arson from those that do not. Examples include records of previous fires, building code violations, police calls to buildings, and tax arrearages. Information regarding these factors is generally available in public records. Thus after the factors related to arson are isolated, computerized systems can be developed to monitor their presence. This information can then be used to predict, prevent, and investigate arson.

The first such effort was funded in Boston in 1978 with $200,000 from the U.S. Department of Commerce. OPE supplied an additional $200,000 in 1979. Also, $20,000 grants were provided Knoxville, New Haven, New York City, Phoenix, San Francisco, and the State of Washington. These seven developmental efforts will now serve as "models" for others.

Another OPE initiative is the creation of an arson resource center. The purpose is to collect and then disseminate information about arson prevention and control programs around the country. A 20-page Arson Resource Bulletin was started in September 1979 to provide for information and resource exchange. It will be printed five or six times per year and distributed to 10,000 individuals nationwide. Also, a 160-page Arson Resource Directory was developed in 1979; it is being printed and will be distributed to 5,000 people in early 1980. It lists programs, people, and other resources related to arson prevention and control.

An anti-arson strategy that has worked in several cities is the arson task force. Included on such a task force are fire, police, and prosecutorial personnel as well as representatives of other State and local agencies, the insurance industry, and the public. The purpose is to develop and implement a community-wide arson prevention and control strategy. In Seattle, for example, an arson task force executed a coordinated anti-arson program that reduced arson losses in two years from $3.2 million to $1.8 million per year. The arrest rate was doubled and the conviction/arrest ratio increased 75 percent.

To promote the use of this promising strategy, OPE has developed a seminar on how to create and implement an arson task force. During 1979, OPE identified individuals in 30 cities with expertise in some aspect of task force implementation and operation -- for example, data collection, public education campaigns, and training of fire investigators. During 1980, OPE in cooperation with the National Fire Academy will use these individuals in conducting the seminar and in offering follow-up technical assistance to individual cities and states. The seminars will be offered in each of 10 Federal regions. Key personnel from 15-20 local jurisdictions will attend each session. This effort is being carried out through an interagency agreement between the U. S. Fire Administration and the Law Enforcement Assistance Administration of the U. S. Department of Justice. LEAA will reimburse USFA in an amount not to exceed $500,000 for conducting arson-related training and technical assistance efforts during the period June 1, 1979, to November 30, 1980.

Some of our recent accomplishments and work currently being done in the area of arson are brifly described as follows:

Office of the Administrator

- The Fifth Annual Conference of the U. S. Fire Administration was held in New Orleans in January 1980, and featured arson prevention and control as the central theme. Arson control programs which have been proven effective were described and demonstrated to over 1000 attendees. Implementation packets for these programs were given to conference attendees.

National Fire Academy

- Four two-week field programs, including a three-day course for fire/arson detection, were conducted in 1979.
- Four two-week field programs, including a two-week course for fire/arson investigation, were conducted in 1979.

- Ten special two-week courses in arson investigation for full-time investigators (fifty students each course in metropolitan locations to be determined) will be conducted with LEAA funding in 1979/1980.
- Ten special two-day courses in arson detection (fifty students in each course in locations to be determined) will be conducted with LEAA funding in 1979/1980.
- A complete course package for Fire/Arson Investigation was developed and distributed in 1979, to Metro Chiefs, State Fire Marshals, State Directors of Training, and Federal agencies.
- Four courses in arson prosecution will be co-sponsored with the National College of District Attorneys in 1979/1980 (65 students per course).
- Since January 1980 the Fire/Arson Detection course is being delivered regularly to resident students at the Academy.
- Since January 1980 the Fire/Arson Investigation course is being delivered regularly to resident students at the Academy.

Center for Fire Research

- A Fire Investigator's Handbook will be published in 1980. This will be a ready reference for field use rather than an exhaustive treatise.
- A device for the generation of standard accelerant concentrations in air was developed in 1979, with a final report on calibration of portable accelerant detectors to be published in 1980.
- A number of commercial accelerant detectors (sniffers) will be evaluated for sensitivity and reliability in 1980. A performance standard will be recommended.
- A report on the psychology of firesetting was published and a functional classification system for arsonists was developed.

Some additional undertakings I envision for the arson area in 1981 and 1982 will include:

National Fire Data Center

- The Data Center plans to begin a program of changes in the existing national fire incident data collection system to begin to record and track arson incidents in enough detail to 1) make accurate estimates of the magnitude of the problem, 2) track trends, 3) identify better the specific types of arson fires that are occurring, and 4) measure loss reduction to evaluate which anti-arson programs work, none of which is possible at the present time.

National Fire Academy

- We will expand the delivery of the Fire/Arson Detection course to insure that firefighters at all levels recognize arson and initiate investigation immediately.
- We will develop and deliver a course to acquaint prosecutors with the special techniques necessary to successfully prosecute arson cases.
- We will expand the delivery of the Fire/Arson Investigation course to meet the needs of volunteer firefighters.

Center for Fire Research

- Develop standards for the collection and preservation of evidence.
- Develop new techniques for the detection and identification of accelerants.

## IMPROVED FIRE PROTECTION

### OFFICE OF PLANNING AND EDUCATION (OPE)

### Resource Network Development

The major objective of OPE is to develop, validate, and distribute nationwide improved techniques and materials for planning and implementing State and local fire prevention programs. This process--promoting the use of new knowledge to improve practice--is what other fields call "dissemination." Dissemination involves transforming new knowledge into useful materials, products, and processes; helping recipients acquire the skills necessary to use this knowledge effectively; and assisting State and local agencies in building the capability to identify and solve their own problems.

Through OPE efforts, fire service personnel and the public have been made increasingly aware of fire prevention materials and techniques; have received training in the use of these materials and techniques; and have, in turn, trained others.

During the past three years, OPE has created and nurtured a fire public education information/dissemination network that now serves as an informal mechanism for sharing fire education information and resources nationwide. People and materials are both integral to the operation of the network.

The Resource Exchange Bulletin is OPE's primary tool for informing the fire service community nationwide of available human and material resources, new promising practices, upcoming events, training opportunities, Federal funding opportunities, and other topics of general interest. Since its inception in 1976, the circulation of the Bulletin has grown from 25 to approximately 9,000. The majority of the mailing list consists of State and local fire service personnel. Others include local and State officials, school teachers, burn care professionals, insurance adjusters, and safety people in businesses. Six to eight issues of the 12-page newsletter are distributed to these individuals each year.

OPE has worked with State and local fire service organizations to identify individuals with expertise in a variety of areas such as planning and evaluating fire education programs, conducting residential inspection programs, implementing school programs, and carrying out smoke detector campaigns. Some of these individuals have been trained through OPE-sponsored workshops. Others have gained expertise through other means such as developing and implementing local programs. An informal file of such individuals who have agreed to serve as resources for others is maintained by OPE staff; at any time the active file includes 120-150 names. OPE sponsors an invitational conference each year to facilitate sharing of knowledge and materials among these individuals. Other fire personnel take advantage of these resources by referral through OPE and by articles and announcements in the Resource Exchange Bulletin.

OPE has sponsored the development and/or production of a variety of materials to promote fire prevention during the past three years. Several items have already been described--smoke detector pamphlets and manuals; the 80-hour residential inspection training package; the manual and training package regarding juvenile firesetters; the Report to Congress on Arson; and the Arson Resource Directory. Additional materials include a series of five manuals entitled The Effectiveness Handbooks for Fire Educators. These "how-to" manuals, are designed to help fire educators improve their programs and present evidence of program effectiveness. The manuals teach documentation and evaluation skills. They are presently being field tested in training workshops.

Another manual, Public Fire Education Planning, presents a five-stage systematic planning model for use by State and local fire organizations. This manual, which cost $10,000 to develop and print, has been distributed to 2,500 individuals, and used in 35 states to plan and implement public education programs. The manual's introductory chapter is included in Public Fire Education, a publication of the International Fire Service Training Association. The planning process described in the manual has also been used to plan an anti-litter campaign in Georgia and will be used to plan an anti-arson program in rural Oklahoma.

In addition OPE has produced six other publications and has distributed 10,000 total copies of them during the past three years.

Many of the OPE materials are used by individuals in the resource network to train others, while some "stand alone" and do not require an accompanying presentation. Others, such as the Resource Exchange Bulletin and the smoke detector pamphlets, are designed to serve primarily as information tools.

## Technical Assistance and Training

Trained consultants from State and local fire agencies throughout the country provide technical assistance through funding and coordination provided by OPE. During 1979, 43 workshops and other on-site assistance programs were conducted with 650 participants.

The primary purpose of the OPE technical assistance effort is to provide professional development opportunities for fire educators. OPE sponsors two types of technical assistance activities: (1) delivery of workshops designed to improve specific fire education skills or to assist fire educators in the use of resource materials; and (2) technical consultations designed to provide fire service and community leaders with assistance in planning fire prevention programs.

Technical assistance is offered in the following program areas:

- Fire Education Planning. Workshops provide instruction and practice in the use of a five-step planning model using the manual, Public Fire Education Planning.
- Juvenile Firesetters. Training is provided in the interviewing and counseling skills needed to deal with juvenile offenders and their families. This assistance effort uses the materials and videotape developed by the L. A. County Fire Department.
- Arson Prevention and Control. Seminars and technical assistance are offered to help states and localities implement arson task forces.
- Public Education Assistance Program. Technical assistance is provided to personnel in PEAP states in the areas of grant reporting, conference planning, activity tracking, proposal preparation, resource development, and evaluation.
- Master Planning. OPE offers technical assistance to communities wanting to develop effective fire prevention and control "master plans."

The master planning process involves the development of both short- and long-range goals. The USFA has released both basic and advanced guides to help communities develop these plans.

- Public Fire Education Specialist Course. This one-week course is offered through the National Fire Academy for firefighters whose duties involve fire education planning and implementation at the local level.
- New Resources. In coordination with the Resource Network, the OPE Technical Assistance Program assists fire educators in using newly developed resources, such as the residential survey training package described above.

Master Planning

The best use of public service dollars, personnel, equipment and facilities is a universal concern in today's economic climate. In an area such as fire protection, which brings together public and private officials and organizations, comprehensive planning can be the key to success. Planning for the effective use of fire prevention and control resources is a local responsibility, since local needs and resources -- and risks -- differ from community to community.

Although the problems differ, the need for comprehensive Fire Prevention and Control Master Planning is universal. Fire protection master planning is a systematic process for determining how much fire risk a community is willing to assume, how much fire protection it can provide and alternative approaches for providing that protection. It is the development of a total community plan by that community. It looks at today's fire situation, anticipates tomorrow's problems, and designs alternative plans with costs and benefits to meet fire protection needs. Based on a master plan, rational decisions for using public and private resources can be made.

The U.S. Fire Administrtion's goal in master planning is to provide leaders at all levels of government with the tools needed for comprehensive fire prevention and control planning. At a time when local governments are struggling to maintain or improve the quality of public services, the USFA master planning tools offer a valuable resource.

The Urban Guide for Fire Prevention and Control Master Planning was officially released on March 29, 1977. The Guide is a step-by-step manual that outlines the procedures for planning and implementing fire protection master plans for urban communities. Since its release, more than 12,000 copies of the Urban Guide have been distributed.

The planning process was originally developed under grants to the City of Los Angeles and Mountain View, California fire departments. Prior to the release of the Guide, 13 other communities pilot-tested and reviewed the planning process, at no cost to USFA other than technical assistance.

The International City Management Association (ICMA) and representatives of communities near the validation cities have given a "third part" assessment of the Guide's usefulness. The ICMA formed teams of city administrators who visited the pilot communities to determine the transferability of master planning. Their conclusion: overwhelming support for the master planning concept and the Guide. ICMA also observed that "master planning's total 're-think' about community fire protection tends to foster a more equitable distribution of responsibilities and costs between the public and private sectors."

While the Urban Guide is a comprehensive document for use in a complex environment, such as a large city or metropolitan area, the Basic Guide for Fire Prevention and Control Master Planning, completed in July 1977, is a simplified version of the key concepts and procedures of master planning. Smaller communities and rural areas are targets for the Basic Guide, developed for USFA by the Oklahoma State Fire Marshal's Office.

In another planning area the Office of Planning and Education developed a simple guide to aid fire public educators in program development. "Public Fire Education Planning: A Five Step Process" is being used by fire public educators across the nation to plan, implement, and evaluate their fire public education programs. Workshops on the five step process have been held in over 20 states. The manual and a slide presentation on its use are available from OPE.

Since 1977, training in the use of master planning techniques has been an important USFA activity. The National Fire Academy is responsible for this outreach aspect of master planning. The National Fire Academy had developed two master planning courses. The first, "Overview of Master Planning," introduces course participants to the purpose, language, procedures, and costs and benefits of master planning. Since 1977, 2000 local fire service personnel and local government officials in 45 states have attended this course.

The second course, "Preparation for Master Planning," readies local government planning team leaders to carry out their roles in master planning. The method of training these leaders is a "hands-on" workshop, simulating a planning team environment. Since 1977, 55 local fire service personnel and local government officials have attended this course.

It is estimated that approximately 1200 local communities are currently engaged in fire protection master planning. Most of this is being done in towns and cities in the 10,000-100,000 population range, and in communities where a high percentage of fire service personnel is employed on a full-time paid basis. Almost all of the planning communities are incorporated jurisdictions.

P. L. 93-498 required that the Secretary of Commerce submit to the Congress a report on the establishment and effectiveness of master plans in the field of fire prevention and control throughout the nation. This report has been completed and submitted to the Congress. It was prepared by the International City Management Association, which was chosen because they are dedicated to improving the quality of local government. It was also deemed desirable to obtain the analysis from an organization that was not involved in developing the master planning program, yet fully aware of the capabilities of local government.

The report is a survey and analysis of the fire protection master planning activities of a large sample of cities and of a number of multijurisdictional county and regional planning units. Without exception these master planning efforts have resulted in improvements of new protection programs aimed at reducing fire losses and increasing the efficiency of delivering fire protection to the community.

Based upon the actual experience of communities as observed by the ICMA survey team, the ICMA report states emphatically that the master planning process is a remarkably effective management tool for helping local communities address the problem of controlling their fire losses. Although significant community commitment of time and effort is necessary, the report's final conclusion was that because of the potential benefits in fire protection afforded by master planning, a way should be found to make the process acceptable to all communities -whatever level of sophistication. The report supports the commitment that the USFA has made in the development and support of the master planning program.

## NATIONAL FIRE DATA CENTER

In terms of deaths and dollar loss per capita, the United States has one of the worst fire loss records in the industrialized world. One of the tasks of the National Fire Data Center is to find out why, and to develop information that can help us reduce the problem.

## OBJECTIVE AND PURPOSE

The National Fire Data Center has four major objectives: (1) to accurately define the magnitude and characteristics of the fire problem in the United States; (2) to help State and local governments to do the same for themselves;

(3) to help disseminate information on the fire problem and the solutions to it; and (4) to assist in the application of technology to reducing fire loss and the cost of fire protection.

Better information is needed at every level of government to help set priorities so that the fire problem, and resources allocated to solving it, can take its appropriate place along with other societal problems, and so that specific fire protection programs can be prioritized. Better information is also needed to target fire protection programs more accurately for different regions, different groups of people, and different parts of the problem. It is needed to assess progress over time. And, it is needed to identify success stories and help share what works. Of course, our goal is to reduce fire losses and improve the cost effectiveness of fire protection.

Data is only a means to those ends. Because there are never enough resources to do all one would desire in fire protection, it is crucial to have accurate data to make informed resources allocation decisions. To the extent that the data is not adequate or available data is not used, we will be operating programs in the dark, and there will be some needless loss of lives and property due to mistargeted programs. There is a growing appreciation throughout the fire protection community that this is the case.

## In-depth Investigations

The National Fire Incident Reporting System, described above, under Assistance Programs, collects some data on a lot of fires. For many types of questions, it is necessary to obtain more detailed data than one can afford to collect routinely on every fire. For these applications we use in-depth investigations of carefully selected samples of fires.

At present, the National Fire Data Center has three major in-depth investigations programs underway. First, we investigate or charter investigations of major fires such as the 1977 Southgate, Kentucky, nightclub fire in a program jointly funded by the Center for Fire Research of the National Bureau of Standards.

The nature of the mobile home fire problem, where fire death rates for occupants are twice that in other types of residences, is our second major in-depth investigation program. We are evaluating the adequacy of the 1976 HUD mobile home standard with respect to fire protection. In this project, funded by HUD, we are working with State Fire Marshals and others in eight selected states to do in-depth investigations according to a protocol we established jointly with HUD, CFR, and NFPA. The mobile home study also makes use of data on mobile homes fires from the National Fire Incident Reporting System, the Consumer Product Safety Commission, and State Fire Marshals' reports. We thus make use of an existing network of trained investigators in the States, help broaden their experience, collect data on a vital project for a regulatory agency, and explore another piece of the fire problem, all at the same time.

Other in-depth investigation projects ones we have undertaken for the Consumer Product Safety Commission, on major fire causes include investigations of fires involving thermal insulation and electrical distribution.

## National Fire Estimates

The Data Center not only collects data, but also analyzes it and draws policy implications from it. Our major product is a series of national estimates reports, entitled Fire in the United States. This report describes the magnitude and characteristics of the U. S. fire problem, compares it to that of other nations and other national problems, and describes the characteristics of the problem in a way intended to be helpful for making fire protection program decisions at various levels of governments. The report is also intended to serve in part as a model for other levels of government in analyzing their own data. In developing the report, we paid considerable attention to the quality of the data presented. Wherever appropriate and feasible, data from a number of different sources was presented, and the validity of the estimates discussed.

Some highlights of the first and second national estimates report are discussed below. We are following up some of the tantalizing observations and questions in more narrowly focused studies.

Fire Deaths, Injuries, and Dollar Loss

We estimate that there are approximately 8,700 deaths; 310,000 injuries; and over $5 billion direct property loss from fire each year in the United States. Total economic costs of fire protection and fire losses are much higher than that -- $20-25 billion, possibly even higher.

The Southgate, Kentucky nightclub fire which claimed 164 lives is a rare exception. Because of the publicity given to a few large non-residential fires, the public misunderstands the fire problem and under-appreciates it. Consider the fact that the annual number of fire deaths is about that which would result from having a Southgate-size fire in every state once a year. Over three-fourths of civilian casualties occur in the home, usually in one and twos.

Because of this situation, a major part of the U. S. Fire Administration and Center for Fire Research program is being directed toward the residential

best copy available

problem.

The intensity of the fire problem varies a great deal from place to place and between urban and rural areas. Alaska, and the Southern States have the highest fire death rates in the nation, in fact, in the world. In any given year, the death rate may suddenly be high in a given State because of one large fire or the laws of chance, but most the States that have a high rates have had them for at least a five-year period.

It is well known that the elderly and the very young have high fire death rates. Death rates for blacks are much higher than for whites; and rural blacks in particular have a disturbingly high death rate. These patterns are quite similar from State to State.

Rural areas and large cities have high death rates; lower rates exist for medium-sized cities.

Data from the rural sector is often of lower quality than that from other parts of the country. It is comprised of a small amount of data from a large number of fire departments; it requires a special effort to verify that the emerging picture is indeed correct, and to find out more about why the rural problem is so severe. Because of the above findings, the Data Center with the Center for Fire Research started a special project in Fiscal 1980 to gather and analyze data on the rural fire problem.

### U. S. Versus Other Countries

As mentioned earlier, the United States fire problem is among the worst in the world, both in human losses and economic losses. In terms of fire deaths per capita, we are about tied with Canada for being highest among the countries for which we have comparable data.

There are many hypotheses about the causes of these international differences. There seems to be a high correlation between fire losses and technological and economic development. For example, electrical energy usage per capita correlates with national fire rates, and wealth per capita correlates with fire rates and losses. But if we eliminate all U. S. fire deaths resulting from electrical ignitions, we would still be in the same rank for fire deaths. There appears to be another, and perhaps even more important issue, and that is the amount of prevention practiced in the various countries, and the degree of public carefulness. These factors are hard to quantify by statistical analyses, but there seems to be, for example, a greater concern in Japan about the hazards of fire than in the U. S., a greater percentage of fire department manpower spent on prevention in Tokyo than in U. S. cities, and more of a social stigma attached to those in Japan who accidentally cause fires than there is attached to those who cause fires in the United States. Germany and several other countries seem to have more highly trained inspectors and stricter enforcement of their fire codes.

## Data Center Assistance To Decision Makers

Our Federal and Industrial Applications group analyzes fire loss data for information needed by Federal agencies for determining the need for regulatory action and the nature of such action, if needed; and for information needed by the industry to identify the fire hazards posed by their products and to suggest what improvements are necessary. Thus, information on fires involving upholstered furniture was provided to the Consumer Product Safety Commission, on thermal insulation for the Federal Trade Commission, on chemical fires to the Environmental Protection Agency, on grain elevator fires to the Department of Agriculture, etc. Among the trade organizations with which we have worked are the Society of Plastics Industry, National Forest Product Association, American Iron and Steel Institute, and the Association of Home Appliance Manufacturers. The industrial firms we have advised on potential new markets for safer products include the Dupont Company, the Dow Corporation, General Motors, Ford, General Electric, as well as many smaller firms. We have also provided information needed for development of new codes or revisions of existing codes to the Arizona Auditors Office; City of Dallas; Grand Rapids, Wisconsin; Bensalem Township, Pennsylvania; and a variety of others.

The Data Center Publications Program was increased in 1979 and 80 to help get fire data used, not just collected, at State and local levels. In Federal programs this objective often is taken for granted, and often does not get accomplished, thereby wasting much of the effort in developing good data and R&D findings. To increase the use of materials produced by the Data Center this program makes findings clear ennugh so busy fire service officers, firefighters, State and local officials, and other "user groups" can grasp results quickly. Complex statistical information, equipment design specifications, and other research results are translated into clear graphics and simple English. This is the important last step in turning Data Center activities into impact in the field.

In addition to publishing and disseminating all Data Center products, and preparing articles for fire and trade journals, this program is responsible for the quality control of all USFA publications and audio-visual products through the Editorial Review Board, and for the updating and distribution of USFA's Publications Catalog to inform the fire community, industry, government officials, and others of what's been produced and where it's available.

The USFA Fire Library is a small unit in the Data Center, devoted to making information, such as the above, accessible to the fire service, industry and others. This is true, not just of U. S. Fire Administration information, but the general fire literature, as well.

Our Fire Library operates in several modes. First, we started Fire Technology Abstracts, which provides substantive abstracts of fire protection books and journal articles published both in the U. S. and abroad. This publication is made available by subscription through GPO to the fire service and others at a nominal price. These abstracts provide a means for the fire service and the public to become aware of fire-related information, not only in the many fire publications, but also in the occasional articles and reports from organizations and sources not in the fire business day to day. The abstracts also include information on patents, foreign research, and unpublished reports. Our paid circulation doubled in the past year. The abstracts are on computer tape so that at a future date when the file size warrants it, they can be loaded with a search service for retrospective searches of the fire literature by computer.

Second, the Library staff answers queries from Federal agencies, Congress, industry, and the fire service, for information on particular fire protection problems. It informs those who request information on relevant documents;

it develops bibliographies or researches questions directly, if possible.

Finally, basic library service is provided for USFA staff and, as time permits, specialized information collections are developed, such as the one we have developed on arson.

We are not doing very well compared to other nations in fire protection, but we are now taking the necessary first step of getting a better handle on exactly what and where the problem is. We hope that this will allow us to make a much better attack on it than was possible before.

## NATIONAL FIRE ACADEMY

The National Fire Academy has recently undergone many changes with the opening of the Emmitsburg site and the increase in staffing to operate the facility. Along with these changes has been a complete review of course offerings, program objectives, and target audience needs. As a result, the educational program for FY 1981 will be structured into a more unified, integrated curriculum with emphasis on two major program areas: Fire Protection Management and Fire Service Technology. This restructuring is prompted by the need to emphasize the professional level required of managers, the need for professional recognition upon completion of specialized fire training, and the focus on the many varied and technical aspects of the fire service. An important part of the curriculum is that courses are designed to provide technical training as well as provide a base for further instruction at the local level and to meet the knowledge and skill levels of the National Fire Protection Association standards. As in the past the Academy will continue to place a great deal of emphasis on the student-instructors who can return to their own communities as "change agents". Through this emphasis, an ever-increasing "multiplier" effect is created, as teaching and learning continues at the state and local level based on model courses at the National Fire Academy.

The Fire Protection Management Program is directed at different areas of specialization, interest, and management and is divided into three specific areas of concentration: Emergency Incident Management, Fire Prevention and Loss Management, and Fire Service Management.

The Emergency Incident Management area of concentration addressess the need to develop effective emergency incident commanders. This concentration includes incident command course areas designed to give the student a basic understanding of preparedness, incident operations, tactics, and command. In addition to the incident command course areas, the concentration includes several speciality course areas such as high rise, hazardous materials, and rural fire control which offers in-depth knowledge on the management of particular incidents.

The Fire Prevention and Loss Management area of concentration is designed to address the needs of people responsible for preventing fires and assuring adequate built-in structural fire protection. Included are such course areas as fire inspection, public fire safety education, building design, and fire suppression and detection systems. This area of concentration is directed at the fire service as well as allied professionals who have responsibility for fire prevention and loss management such as architects, engineers, planners, and insurance underwriters.

The Fire Service Management area of concentration addresses the need to increase the professional level of officers and managers responsible for the day-to-day operation of the station, department, or larger fire service component. This area of concentration offers course areas designed to develop line and chief officers and provide detailed knowledge in specific management areas such as emergency medical services, safety, and budgeting.

Within the fire and rescue service there are many specialized areas of technology. In order to address these needs, the Academy's second major program, Fire Service Technology, includes course areas such as instructional development, arson and fire investigation, and fire and rescue skills.

An important part of the educational program is not only the knowledge and skill provided but also providing recognition for successful completion of a course. In order to address this Certificates of Recognition will be awarded in the speciality areas of Emergency Incident Management, Fire Prevention and Loss Management, or Fire Service Management, whichever is appropriate, after the student meets the prescribed requirements.

The awarding of Certificates of Recognition in the Fire Service Technology Program varies somewhate from the Fire Protection Management Program because this Program is aimed at specific technical training rather than an integrated, comprehensive management education. The following Certificates of Recognition will be issued for successful completion of the prescribed courses, as follows:

1. A Certificate of Recognition as a Master Instructor for completion of the three levels of Educational Methodology.
2. A Certificate of Recognition of Fire Investigator for completion of the Fire/Arson Investigation and Fire/Arson Detection courses.
3. A Certificate of Recognition in Professional Firefighting Technology for completion of the three levels of Firefighter.
4. A Certificate of Recognition in Professional Rescue Technology for completion of the three levels of Heavy Rescue.

Individual course certificates will continue to be presented for successful completion of any courses offered through the Fire Protection Management or Fire Service Technology Programs.

In order to reach the maximum number of people within the available resources, the Academy will offer eductional programs at the campus facility during the week, specialized programs on the weekends, and cluster courses in the field through the Outreach Program.

The Outreach Program will have an emphasis on the local volunteer and career departments and is designed to present courses off-campus to address local needs. This program will include portions of both the Fire Protection Management Curriculum and the Fire Service Technology series mentioned before. The Academy Faculty delivering the Outreach courses will be supplemented by contract or local instructors. Each geographical area will be surveyed to determine particular education and training needs, and the desired courses will be offered at locations convenient to the students.

An integral part of the Outreach Program is the Open University Program which permits firefighters access to higher education across the country in recognized universities. It also permits participation by those firefighters who, because of distance or time limitations, normally would not pursue higher education.

Recent accomplishments and work currently ongoing in the area of Improved Fire Protection include:

Office of the Administrator

- o A National Workshop for the Volunteer Fire Service identified the needs and concerns of the volunteer fire service. This workshop was held in Colorado in August 1979, and included representatives from 49 states.

Office of Planning and Education

- o An EMS Resource Bulletin was published in 1979. A plan for a coordinated USFA EMS program will be drafted, drawing heavily on input from the field.
- o Twenty-five communities received assistance in developing Community Master Plans in 1979. Experience will be documented.
- o A Report to Congress on the status and effectiveness of Master Planning will be prepared in 1980.

National Fire Data Center

- o A study on the impact of Proposition 13 on fire protection services (California Fire Chief's Association) was completed in 1979.
- o During 1979 and 80 a series of materials on fire data collection and analysis are being sent out through the State Fire Marshal's of NFIRS States to participating departments, also the NFIRS News was started and a Telephone Directory of key NFIRS contact people in each State was published to assist the fire service in the development of their data systems. With these tools and through our annual NFIRS-wide users conference, the NFIRS network, now numbering over 6000 departments, is sharing know-how and helping each other in putting fire data to use in a wide variety of ways that are improving fire protection delivery at the local level.
- o Tape and slide workshop materials, and the monograph "Data Collection, Analysis, and Processing" prepared by the Data Center and published in the ICAM's text book Managing Fire Services are also being disseminated through the NFIRS network. A full manual on how to use data from NFIRS in fire department management will be published by the Data Center in 1980.

- Information is being gathered from metropolitan fire departments on the tactics and equipment the are using to fight fires in highrise buildings, which will be published during 1980.
- To assist department which plan to buy or replace pumpers -- the major expenditure for volunteer departments and a significant budget item even in large city departments -- we have prepared a step-by-step manual for determing the technical specifications the department needs to come up with to buy a pumper that meets its needs, but is not over-designed and over-equipped (and over-priced).
- The operations manual of four city fire departments determined to have good inspections programs are being disseminated to serve as models to help other departments improve the administration of their code enforcement programs.
- The Data Center is working with the American Bar Association to identify legal mechanisms or actions such as the giving of parking ticket-like citations, and others for improving code administration in a cost-effective manner.
- A study on Fire Department Personnel Scheduling was completed in 1979.
- In 1979 and 1980, reports will be issued on individual major fires which occur, presenting lessons learned on how to prevent and/or control large loss fires.
- The First report on Manning Studies will be completed in 1980.
- A study on the Identification and Characteristics of Volunteer Fire Departments will be completed in 1980.

## National Fire Academy

- Curriculum development on a course for Management Overview II was completed and delivered along with the previously developed Management Overview I, as parts of the four two-week field programs in 1979.
- Curriculum development on a course for Public Fire Education Orientation was completed and delivered as part of the four two-week field programs in 1979.
- Curriculum development on a course for Preparation for Master Planning was completed and delivered as part of the four two-week field programs in 1979.

- Curriculum development on a course for Public Fire Education Orientation was completed and delivered as part of the four two-week field programs in 1979.
- Curriculum development on a course for Preparation for Master Planning was completed and delivered as part of the four two-week field programs in 1979.

- Three two-week field programs, including a course for Life Safety Code 101, was conducted in cooperation with NFPA in 1979.
- Four two-week field programs, including a course for National Fire Incident Reporting System, Pesticide Fire and Spill Control, and Education Methodology I were conducted in 1979.
- Regular delivery of the Executive Development, Fire/Arson Investigation, Hazardous Materials Spill and Fire Control, Education Methodology I, and Public Fire Education Specialist courses to resident students at the Academy commenced in January 1980.
- Curriculum development on a course for Educational Methodology II will be completed and delivery will be initiated during FY 1980.

### Center for Fire Research

- Recommendations on performance of sprinklers and detectors in health care facilities were submitted to HEW in 1979.
- A report for HEW on relative safety impact of selected subsystem elements, including sprinklers, door closures, and other elements, will be published in 1980.
- A laboratory for the study of explosion and electrical fire hazards will be completed in 1980.
- Fire scenarios for telephone switchgear fires will be developed and verified experimentally.
- A method for detecting phosgene in fire gases will be published. Large-scale experiments to determine the significance of phosgene in electrical insulation (polyvinylchloride) fires will be carried out.
- A report on fire hazards on conveyor belts in mines will be published.
- A report on fire hazards on hydraulic fluids in mines will be published. Recommendations will be made on fire safety of solar collection systems.
- A test method will be developed for ignition-resistant transformers fluids in 1980.
- A Fire Safety Evaluation System for determining alternative means for fire protection of prisons will be completed in 1980. Full-scale fire tests of prison cells will be completed and evaluated. The results will be applied to modification of the Life Safety Code requirements for prison facilities.
- A Fire Safety Evaluation System developed by CFR for HEW in 1979, will be delivered to the field by OPE in 1980.

- Procedures for providing improved fire protection of existing open stairways will be completed in 1980. A computer model for pressurized stairwells will be completed and published.
- A standard-room fire-test protocol will be submitted to ASTM. A reduced-scale shipboard compartment test will be recommended to the Navy.
- Ventilation requirements for container ships carrying hazardous materials were recommended to Internation Maritime Consultative Organization through the Coast Guard. Field tests of simulated smoke movement in actual merchant ships will be completed and analyzed. A technical report providing background for the recommendations will be prepared.
- A rate-of-heat-release test method based on the measurement of oxygen consumption will be developed.

In 1981, 1982 and later, we will undertake the following tasks in the area of Improved Fire Protection:

### Office of Planning and Education

- Increased emphasis of the fire service as the first response in emergency medical and disaster situations.
- Widespread adoption of the fire protection master planning procedures.

### National Fire Data Center

- In 1981, seven States will be added to NFIRS with start-up grants of up to $25,000 each, with second-year grants going to the seven states started in FY 80. Technical assistance will be provided to the NFIRS states on how to use the data, data collection procedures, data processing , and NFIRS management. (National Fire Academy will provide initial training.)

- Each year we will work with 60 selected communities in each of nine states to implement improved quality control procedures for NFIRS data collection. These procedures are passed to neighboring communities as the improvements in the quality of the data are recognized. This is important for local data analysis and is especially useful for evaluating trends in the U. S. fire problem.
- We will continue the in-depth investigation programs for Federal regulatory agencies as funded. In 1981 we will investigate and analyze the leading cause of fire--heating--to determine exactly what goes wrong and decide on the behavioral, manufacturing, installation, or built-in detection and suppression approaches most appropriate for central heating, space heaters, fireplaces, woodburning stoves, etc.
- Thirty of the major fires that occur in 1981 will be investigated. These fires get wide press coverage and offer the Administration the opportunity to speak out on fire prevention to a wide public, in addition to teaching us specific lessons about the conditions that lead to serious fire losses.
- It is expected that over a million fire incident records will be entered into the National Fire Data Base during FY 1981.
- We will continue to interpret data from NFIRS and other sources to provide hard data for targeting the fire programs of USFA and other Federal agencies; to promulgate cost-effective, fire-related Federal regulations (data may stop ill-advised regulations as well as support good ones); to respond to fire information needs of the fire service, the media, and government and private agencies; and to promote the design and regulation of fire-safe buildings and products through industry's trade associations and voluntary standards communities.

- National estimates will be published of the U.S fire problem that can be used by OMB and Congress for assessing prioroties of fire vs. other national problems and for assessing progress over time. This will also provide comprehensive characterization of fire problems with sufficient specificity that individual communities and States will have a baseline for evaluating their own problems.
- Data will be collected and analyzed on several critical characteristics of fire departments and communities to produce important gross measures of risk so the true threat of fire and its changes can be assessed at local and state levels.
- During 1981 and 82 the Data Center will conduct field data collection, test fires, mathematical simulations, and overall analysis to determine the incremental benefits (or detriments) of changes in manning levels in fire departments; and will develop a methodology for fire departments of different sizes and situations to use in choosing crew sizes appropriate for their companies. Formation of an advisory group from the management, labor, and research sectors is included.
- In 1981 we will develop code guides and management handbooks to assist State and local officials in improving inspection program management and the enforcement of codes.

## National Fire Academy

- Development and delivery of courses in such areas as Wild Land Fire Control Management, Urban Fire Control Management, Aircraft Fire Control and Crash Rescue Management, Fire Protection Codes and Ordinances, Fire Safe Building Design, Fire Prevention Considerations of Hazardous Materials, Fire Officer I and II, Development of Master Plans, Management of Emergency Medical Services Programs, Community Relations in the Fire Service, Administrative Communications, Volunteer Fire Department Management, Volunteer Fire Department, Financial Administration, Firefighter Skills, Heavy Rescue, Fire Service Vehicle Driving and Fire Service Vehicle Specification Writing, which will fill the void of state and local fire service organizations, meet local needs, and offer positive results on the reduction of loss of life and property due to fire;

- Establish the Academy as a model training institution offering courses which meet nationally-accepted professional standards.
- Developing a well-rounded fire service professional who can serve the community in the areas of fire prevention, fire suppresssion, and life support.
- A continued effort to have all states participate in the development of master training plans and organizational designs under the Academy Planning Assistance Program
- Constantly evaluating current courses and programs to insure their value to the fire loss reduction effort.

Mr. Chairman, this concludes my prepared statement, I and my staff will be pleased to answer any questions you or members of the Committee may have.

Mr. BROWN. Thank you very much, Mr. Vickery.

We have a number of questions that we will propound to give you a chance to elaborate on some of these points and may require some assistance from your staff.

I want to say that the report that you have made is encouraging one which we are pleased to hear. You are heading up a new operation which has experienced some problems. You obviously are going ahead in a positive fashion with a lot of achievements to your credit, and certainly I commend the philosophy you have expressed of basically seeing your role as supporting and reinforcing State and local efforts, which I think is as critical to the success of the Federal effort, unless we want to make the Federal Government responsible for fighting fires all over the country. I don't think that we do.

My question is, you can't really be this good. You must have made a few mistakes along the road here.

Would you care to tell us some of the things that you haven't been able to solve adequately?

Mr. VICKERY. Well, the first mistake I made, that I can recall in this area, and I made thousands of them, was when I was in Seattle last weekend, and it was 55 degrees and clear, I was over at my beach place, the first mistake I made was coming to Washington.

But aside from that, that is a little facetious of course, I do like being here and being in this rather challenging job.

Yes, we have made some mistakes.

I made a number of them when I was the acting director of FEMA, I think, in the matter of managerial decisions.

I think one of the mistakes we continue to make at the U.S. Fire Administration is that I am concerned we don't evaluate programs enough in depth or maybe not even superficially at times.

I think that we have come up with a number of good programs. I don't know that I could answer you effectively and fully that each of them is working in the manner we chose.

That is what I consider, if you want an elaboration of a mistake, we do need better evaluation within the U.S. Fire Administration.

I don't know how you would define a mistake. If I wanted to make everyone happy, I would not choose problems such as women in the fire service, and resource allocation manning. I don't know if you call that a mistake.

I would guess that I could list a number of things that I would have done differently. I can't predict what the outcome would have been, had we done them differently, so I don't know if you could elaborate on those as mistakes, Mr. Brown.

Mr. BROWN. Well, this committee, I think the Congress supported the creation of the Fire Administration, and the development of the Academy because it was recognized the national importance of the fire problem, and the need to provide for a limited Federal role in helping to address that problem on a national basis.

I think possibly the Congress has a higher sense of priority of this, than perhaps the administration does, or maybe we are just not realistic about what can be achieved. I don't know.

I do know, and I am going to ask you to comment on it, that we have received from the administration a level dollar budget request for fiscal year 1981 which means an actual decrease, if you considered the effects of inflation.

If you still had to get the limited amount of money that you spent on arson by cajoling it out of the law enforcement systems administration, and I am wondering if the Congress has some misconception about the importance of these programs, or something is wrong somewhere.

I want to ask you to comment specifically on the overall level of funding and whether or not that reflects the request that went forward from your administration, and whether or not you made an effort to secure funding for the arson program?

Mr. VICKERY. Mr. Chairman, I think that is a two-part question.

No. 1, there was an adjustment today from OMB, but in essence we got what we requested from the administration, recognizing that we are in a year of development and refining and trying new ideas. I feel we were funded at the level that we requested and have adequate funds to do a specific job.

Obviously, if you ask me the question what would you do if you had $5 million additionally, I could list a number of things.

Mr. BROWN. Keep them in mind because I am going to ask you.

Mr. VICKERY. OK. I thought you might.

We are working within FEMA at the present time, John Macy, myself and others, trying to define exactly what can be spent effectively on arson. I think this is the existing funding that some $9 million by LEAA and with $500,000 directly allocated to us, plus some substantial funds from within our own organization that we are addressing the problem as effectively as we can at the moment.

As the programs that are now out there come to fruition, an additional look may have to be taken at the arson issues.

And I would ask John Macy to comment if he wishes here. We are now in-house looking at the arson situation and specific funding on that.

Mr. MACY. Yes, we are.

I think that the fact that the funds were obtained from the Law Enforcement Assistance Agency is indicative of the role that FEMA should be playing in working with the Fire Administration and other components in identifying allies in various parts of the Federal Government who have a common interest in solving a particular public problem

The reason I am so enthusiastic about the arson program is because I feel that this is a place where we can bring resources from a number of programs together, achieving an objective that also calls for joint action at the local level.

In many ways the campaign to root out arson needs to be a managerial effort to bring together the fire, the police, the prosecutor, the public works official, and others in order to have an effective attack.

As far as the overall funds are concerned, we reviewed with Gordon Vickery the estimates that had come forward from the Administration, U.S. Fire Administration, prior to the creation of FEMA and we concurred in them.

We had not had an opportunity to independently evaluate the validity of those estimates, but in our view the program that was outlined by Gordon Vickery and his associates appeared to be a proper level of growth in achieving the objectives that were mandated in the act.

Further, we had during 1980 and into 1981 the necessity of assuring ourselves that we did have the National Fire Academy in being, functioning effectively, and contributing to the enhancement of the capability of the fire service across the country.

So rather than move beyond those figures, we proceeded to justify that level and that was accepted by the Administration.

Mr. VICKERY. I think there is an additional point, Mr. Macy, that you could make. Let's talk about adjustments within FEMA.

Let's take the instance of putting 10 regional fire representatives out in the field. We simply did not have the funding as they were not planned originally. I presented my arguments, and the funding for those positions is coming from reallocation of funds that Mr. Macy made within FEMA.

Mr. BROWN. Well, that, of course, is an indication of the power you both attach to the need to decentralize the fire function to some degree. I think that is highly commendable and compatible with the recognition of the importance of maintining the best possible communication and liaison with the local agencies.

On the other hand, it also indicates if you need program funds from—well, I won't touch that point.

The question that you suggested that I ask, do you have a list or program of additional activities which you consider to be of value to the overall needs of the Fire Administration that you would be able to undertake if you were to receive an additional $5 million in your budget, if so, would you give us an indication of what they are, and the priorities which you would attach to it.

Mr. VICKERY. I don't have a listing of specific dollars for you.

But let me give you some generalized areas where obviously there can be an enhancement of existing programs.

One would be the Office of Planning and Education. There is absolutely no question that the assistance program to States and communities can be expanded and enhanced.

We have been into a total of 12 States with programs. Whatever that assistance program might be for the States, Office of Planning and Education does have the capability of expanding that program. We think it has had its pilot phase.

Certainly one of the programs John Macy and I talked at length about, recommended by the ISETAP group, where some 20 Governors and mayors met, and made a recommendation as to what they considered priorities for fire in resource allocation; manning of fire companies; what you should really have on a fire company and how should you allocate the resources of a department in a cost effective manner.

Tied closely to that and of deep concern to everyone is the matter of firefighter health and safety. Recognizing that firefighting is one of the most hazardous professions in the world and that there is a substantial cost to communities for any firefighter that is injured. It is a program that is going to need a significant amount of attention and funding.

Data has established itself now as a national tool or weapon in the fight against arson. It could be enhanced.

If we look to the National Fire Academy, recognizing that we are just getting under way out there, and that we have adequate funding for making structural improvements, capital improvements, the big area there that would and could have enhancement is the matter of our out-reach programs and how do we expand our ability to convey this knowledge out to all the 50 States.

Those are just some examples.

I don't have specific dollars for you. But those are obvious, all priority items in four different program areas.

Mr. BROWN. Could we assume in the next budget cycle you would make an effort to obtain funds in those areas that you have indicated?

Mr. VICKERY. I think we will be addressing them and presenting our points.

Mr. BROWN. Mr. Anthony, I don't want to preempt all the time here, if you would like to break in with a few questions.

Mr. ANTHONY. Mr. Chairman, I appreciate the opportunity to sit with your subcommittee. I am interested in this overall subject. In fact, I have had Mr. Vickery and many members of his staff in my office so that we could talk more about master planning. You have master planning on your program for Thursday, and I have asked to be a witness so that I can testify for the record at that time.

My interest in coming today was for my benefit, so that I may have a better understanding of the problems associated with the U.S. Fire Academy and with FEMA.

I recently held a 1-day seminar on rural fire protection in my district. I am very, very interested in this area. On a day when it looked like it was going to snow 6 feet deep, I still had over a hundred participants representing 32 small communities scattered throughout my 24-county district. So the interest is very keen in the area.

I recently talked with Mr. Vickery about having the master planning consultants come to my district to meet with interested personnel and discuss the grandiose plan that I have. I will like to have all 24 counties in my district adopt a master plan, not only for rural fire protection, but also for providing emergency medical services and possibly tieing in some law enforcement personnel facilities, too. I represent a rural area scattered over such a broad spectrum of territory.

I guess I am really interested in the area of master planning and what the U.S. Fire Academy can do for the man on the ground. The one single question that was asked more often than anything else, is whether or not FEMA will be allowed to have access to Government equipment, so that it can be loaned or sold to small communities. It is the only way they have been able to get started in the past. They are totally convinced that it is the only way they are going to get a foothold on the future.

Mr. Chairman, when grown men in a town of no more than 700 will dress up like women, go out on a high school stage, and sell tickets for a dollar each so they can raise enough money to build a shed to protect their equipment then I can tell you there is keen, strong interest in south Arkansas for rural fire protection. I feel this is true not only in my State, but probably throughout the United States.

So I would like any information that you can give me on these areas in which I am keenly interested.

We have got to find some mechanism to get the rudiments of equipment to the people. Without that, I would say they are going to lose interest real fast.

Mr. VICKERY. What happened, of course, as the DCPA was transferred from the Department of Defense to FEMA the statute which allowed the loan of materials such as you are suggesting, was not transferred along with the organization.

Mr. Macy, I don't know if you have any additional comments on it. It is the most common question we get. I am sure it is the same for Mr. Macy.

Mr. MACY. Well, it is.

This probably is the most popular topic in correspondence and in conversation as I go around the country and talk to civil defense people and to fire chiefs.

It is very clear that particularly in small jurisdictions, this authority has meant a great deal. It has been the means by which many of these communities are able to acquire excess property from the Department of Defense, and then largely rehabilitate it and modify it through their own efforts.

I was in a rural district in Minnesota in January, and with great pride the civil defense director showed me his fleet of vehicles to use for snow removal, and he explained they acquired every one of them through this program, but the changes that were necessary in order to utilize it for snow removal had been the labor of the people in that community.

What Gordon has indicated has occurred and we are in the process now if developing legislation to permit the transfer title of that equipment from the Department of Defense to those who have been recipients of it. That is step one.

Step two, we are in the process of inquiring of State and local officials what the vehicle requirement really is, so that we can come back to you in Congress with an indication of the magnitude of this program, the type of vehicles that are involved, and then to request either an extension of the previous authority to FEMA or some other process by which the Federal Government can make this assistance.

Gordon, I believe you received a number of queries from the fire departments around the country as to whether the fire program would have assistance of this type for fire departments.

Mr. VICKERY. Yes, I did and we do not.

Mr. MACY. You do not.

Mr. VICKERY. No.

Recognizing it might not strike a note of sympathy with you, Mr. Anthony, your original concept of master planning, if it is used universally will start to address some of those problems locally.

Again, I hope that when surplus material is available that we can come up with a mechanism to provide it for them.

I obtained some myself both as the fire chief of the city of Seattle and superintendent of Seattle City Light Co. and used them very effectively.

One of the things we would hope to address in master planning is consolidation of some of the fire districts that exist in the United States. I will speak of my own county in the State of Washington in which we have a rather ridiculous situation. There are 36 fire districts in King County. They don't all need a headquarters and they don't all need a firetruck and they don't all need hose bought separately.

I think we need to help the people that you are suggesting need help. As we look at the master plan concept of addressing the fire problem in an area, there are consolidations and other methods of helping them pool their equipment. I don't think we always do that.

California has done a rather unique job in their statewide program where you have a basic or fundamental fire response team in a community. If you need help someplace else in the State, the State has provided a basic fire unit or units which are stationed around in various areas. If you have a real problem you move them in a given area to solve a major problem.

I think we can address part of the problem with what Mr. Macy is suggesting with legislation. The rest of it we can address by educating the people that there are cost effective methods of pooling and helping each other, recognizing that in real rural areas there probably are never enough fire companies to serve.

Mr. ANTHONY. If I understand Mr. Macy correctly, he is saying that although you have received numerous inquiries, in order to satisfy yourself, you want to put together a study to verify with some facts and figures on a State-by-State basis that the legislation is needed.

What I am saying is that you ought to read your mail and you ought to listen to the Congressmen who are telling you that is what is needed. You ought to take the study and throw it in the wastepaper basket. The law should be passed that transfers surplus equipment from DOD to FEMA so you can start telling little Cooterneck Fire Department, "Hey, we finally got it back. Make application and get some of this equipment if it is available."

That is what the people down in Cooterneck want to hear. They don't want to hear the Federal Government is studying the problem. That is what I hear when you say that.

Mr. MACY. Well, I regret if that is the message conveyed.

My belief is that it is not a study but that we have an obligation to come to the Congress to indicate what the magnitude of the demand is in order to have an effective brief in support of the kind of legislative action that would appear to be indicated.

Mr. ANTHONY. I don't disagree with that format. What I do disagree with is that many times when you set about trying to put that type of information together, it takes longer to solve a problem that we know exists. You have an awful lot of interest in little bitty communities that wanes and goes by the wayside.

As the facts and figures already show, Arkansas is part of the Southeast and it stands out very graphically. I don't know if you showed any slides, but it stands out very graphically even though we are not participating in your data research. We have one of the highest death rates per million population in the country and something ought to be done about it. I want to do something about it, but I don't want to have a study done.

What I want to do is have the law changed so that FEMA has the right to get the equipment back like they used to have. When I go and only hear a hundred people, and this is the one thing that they holler and yell and shout and say, then this is what they need more than anything else.

I can tell you from the standpoint of just one vote, I don't need a study to say it is the right thing and the Government's property is going to be spent wisely. So just take one small voice in the wilderness as a desperate cry for help, and let's move fast on it.

Mr. Chairman, that is really my major area of emphasis and concern at the present time. I have had excellent cooperation from Mr. Vickery and his staff.

Mr. **Brown**. We are looking forward to your statement for the record on this problem, Mr. Anthony, and we welcome your interest and participation and all efforts to improve the fire service throughout the United States, if it rubs off a little bit on your district, that is a lot of good also.

Mr. **Anthony**. I appreciate that.

Mr. **Vickery**. Mr. Chairman, I don't know if it would interrupt the flow of program if we showed just one slide, and I talked on this subject for 3 or 4 minutes. Would that be appropriate.

Mr. **Brown**. It would be appropriate.

Mr. **Vickery**. OK.

Maybe if we could dim the lights.

I think this gets at the root of the problem, Mr. Anthony, and what you were talking about. If you look at the States colored in black, you have the highest fire death incident rate in the United States.

Mr. Schaenman, do you want to elaborate a couple of minutes on anything else there statistically?

Phil Schaenman is the director of our National Fire Data Center, and I will get back to the concept that we want to use down there.

Mr. **Schaenman**. You will just have to hold me down from elaborating too much.

A couple of points about the map. You have seen similar maps before in previous years, one of the startling things there is that it is not changing. The Southeast remains the highest fire death rate area in the country with the highest fire death rate in the world.

One of the breakthroughs we have had this year with the cooperation of the Center for Fire Research at National Bureau of Standards is that we found out the reasons for the death rate being so high in the Southeast. The leading cause turned out to be heating systems, fixed room heaters, space heaters, and fireplaces generally used improperly.

The second leading cause is smoking which is the first cause nationally.

Another fact we found about the problem at both extremes, in the large cities and in the very rural areas where the fire death rates are the highest, is that it is a combination of very high fire rates per capita and also increased severity per capital. The rural areas have both more fires per capita and worse fires per fire.

Mr. **Brown**. Does that indicate a less effective response time?

Mr. **Schaenman**. Probably. It is probably in the rural areas at least partly due to having volunteer fire departments spread out and also greater lack of prevention programs and prevention education than we get in the cities.

Mr. **Brown**. Perhaps inadequacy of the equipment, also?

Mr. **Vickery**. Surely.

Mr. **Schaenman**. Yes.

One of our other breakthroughs this year was the ability to look at the county level instead of just the State level in terms of fire deaths per capita. You can see in the patterns that there is a lot of detail in the Southeast and other parts of the country, also. There are many counties that are doing very well right next to areas that have extremely high fire death rates. The dark areas are high.

One State by coincidence which we have is California——

Mr. **Brown**. Let's see more of those coincidences.

Mr. **Schaenman**. You can see that California has some shaded black there. They have very high fire death rates whereas many of the counties are very low in death rates.

In fact, when you look at the adjacent States like Oregon you see the southern part of Oregon also has a high fire death rate.

We have the ability to target on particular parts of your district to see just exactly where the problem is most severe.

Mr. **Vickery**. Can we switch back now, Mr. Schaenman, to the original showing of the Southern States?

Some of the exciting things that happen and why my remark was facetious about coming back from Washington west to Washington east, was the ability to look at some of the potential in resolution of the fire problem.

We are at this moment brainstorming in-house about what do we do about those nine States. I believe there are nine colored in black, is there any kind of a program we can bring in there or a group of programs that will change the coloring of those States? In other words, significantly reduce the problem.

I don't think that we have the equipment, resources, or tools at the moment to do all of them. We are certainly willing and have almost reached a decision this morning to go for two States and throw all the Federal resources that we have or FEMA has into those two States. Congressman Anthony, I have spoken to you about this participation.

You indicated you would be willing to go to the Governor and get his assistance. Get the local people working. I think it needs a good name. We are talking about Operation Dixieland. In other words, its got to have some saleability to get people's attention, and I think, that we can in a period of 2 to 3 years go into a couple of States with all the resources, talent, and ideas that we have and show a change in that chart.

If we can't, I am not so sure we should be in business.

It is an exciting thing and we will be trying to implement this. I have talked to Mr. Macy. He supports the idea, and I think it is an exciting thing. If we can do it in two States, we can pattern a program or programs and get local support and with Federal assistance and guidance, actually significantly change the fire incidence and fire death rate in those States. It merely services as a model.

That is an example of some things, sir, that I think can be done.

Mr. **Brown**. Let me expand on this for a moment, Mr. Vickery.

I am doing this in order to try and get a message across.

This committee has a very deep concern with the adequacy of what you might call scientific and technological information systems. It is a little broader than that. You can call it scientific society information. It is the kind of data that you are presenting there, based on which allows us to understand and make policy about critical national problems.

This has attracted the interest of the White House and they developed a prototype of a digital information display system which your maps fit into very nicely.

Mr. SCHAENMAN. The charts use that system. That is the NASA system.

Mr. BROWN. I want to go beyond that to point out that this is integral to the whole purpose of your fire data center.

We need to use this as the central focus for establishing the fire data collection system that can be used in every city, county, and State, and it can be accessible so we can use them when it comes time for your budget review and all the rest of that stuff.

Along with that, fire isn't the only problem we have. In those same counties there are going to be other kinds of emergency problems in the health field; I can recall several years ago we had a set of maps like this that were prepared by the National Cancer Institute on the incidence of cancer.

The problem here is developing the epidemiological base that will allow us to make the decision, why was cancer in these particular counties, just like why is fire in those particular counties.

We need a coordinated, central data base, and into which this can fit and in its perfected form, as well as other data bases to allow intelligent policymaking at whatever level the policy needs to be made.

The cities and counties in that area would like to have available a data base that will allow them to make reasonable policy decisions.

We are not advanced very far in having this and I tell you, Mr. Macy and I tell you Mr. Vickery, that you are in a key role in regard to this because you have national emergency management functions which justify your thinking in national terms about the importance of this kind of data collection and analysis and display. And it goes beyond the fire service. And I don't know whether you even include forest fires on there. Maybe you don't.

But I am saying you may be looking too narrowly at the role which you could be playing in terms of the importance for the Nation in what you are doing there.

Now, of course, I am speaking a lot out of ignorance which is common of Congressmen, but I am trying to convey what I think is an important concept here which I will want to pursue with you at greater length in years to come, Lord willing, and so you might as well be thinking about it now, because we have the technology, the computer systems, the communications systems, all of these technologies are now available for you to do these kinds of things and to really serve local government, and in all of its phases and in a much more effective way than we have been able to do it in the past.

Now, do you differ or disagree with anything that I have said, am I being unrealistic or ignorant?

Mr. VICKERY. I think you are on target.

Mr. Schaenman might want to spend just 2 or 3 minutes elaborating on how local government is using this. In fact Congressman Anthony has agreed to go with us to the Governor of Arkansas.

We have not been able to sell this in some States unfortunately. He has been willing to help us. As to the technical aspects, I don't see anything that the chairman has indicated that is inaccurate at all.

Mr. Schaenman, do you have some elaboration to add as to what direction you think we should be going?

Mr. BROWN. Do you have with this the information which would allow us to identify the reasons for this do you have a system which updates and keeps this thing current so that we are not looking at something that was true 5 years ago, we don't really know what the current system situation is because there is no current system for access of the data?

I assume that you can give a positive response to those questions.

Mr. SCHAENMAN. The answer is yes, yes and partially.

May I just show a few more slides?

One personal comment, I completely share your thoughts that this fire data system really is analogous and can be the leader for many other kind of urban data systems. In fact, before I joined the Fire Administration, I was in the Urban Institute in Washington. I selected to go into the fire field because it was ripe for this kind of development of data systems that I thought could be an example for other services.

Mr. BROWN. The occurrence of the census places emphasis on this because they collect huge amounts of data which in many cases are relevant to analyzing——

Mr. SCHAENMAN. Absolutely.

Mr. BROWN [continuing]. The problems you confront with this kind of thing.

Mr. VICKERY. Mr. Schaenman, before you start the partial answer, we have pilot programs going in two states to now add emergency medical service to this reporting system, Mr. Chairman.

I think it is vital as you start to assess the fire department and its productivity and allocation of resources, that we have that fed into the data system, too.

Mr. BROWN. Go ahead.

Mr. SCHAENMAN. We have this kind of information State by State now.

Mr. BROWN. May I assume you have it county by county?

Mr. SCHAENMAN. Yes.

The data is county by county, it can be aggregated actually by congressional districts and below that by census tracts. Now, this is just death information though.

Up until now, the information has been coming from HEW for health statistics, because every time you put a body in the ground, you get a death certificate, and you can analyze that data in every county in the country.

But that doesn't tell you the causes of the fires, and it doesn't tell you the injuries, and doesn't tell you dollar loss information, and the kinds of occupancies, and many other things you would like to know.

Mr. BROWN. The quality of the data stream.

Mr. SCHAENMAN. The quality of the death data is pretty good, but it is not as good as it could be.

It is leaving out a tremendous amount of the problem you need to analyze.

We set up this national fire incident reporting system in order to try to get a common data base at every level of government as you were suggesting.

Local, State, and national, and the general idea is to collect a common core of information on each fire and have that data flow to the State.

The State sends feedback reports back to the local government, and we tap the State data bases, quarterly, to form the national data base.

That data is available day to day and we do answer congressional questions day to day, and we answer questions from the press. We even answer questions from the local government on how they are doing and how their neighboring governments are doint.

Of course, we can answer questions in the rural areas, for example, where a single rural government doesn't have enough data to get statistical validity on a question and you can ask for a region around it, you know if there is an emerging problem.

But we do have a problem with many States not participating now, including, unfortunately, Arkansas.

Mr. ANTHONY. Can I interrupt you?

Mr. SCHAENMAN. Yes.

Mr. ANTHONY. At the seminar that I held, I asked the new director, Mel Goodwin, about this. He indicated that all of the papers had been executed and that Arkansas is now, I guess, in that bottom category in the development stage.

Do you have any information that would confirm or deny that?

Mr. SCHAENMAN. It is not correct. We do not have any application from Arkansas as of this date to obtain a grant or to get formal technical assistance. There has been a lot of sniffing around.

Mr. ANTHONY. To become a reporting State.

Mr. SCHAENMAN. But nothing concrete has happened yet to my knowledge.

We see the fish around the hook, but it is not on yet.

Mr. ANTHONY. Just keep fishing.

Mr. MACY. Do we have better bait?

Mr. SCHAENMAN. There is another aspect to your question, Congressman Brown, about comparing the fire data to other kinds of data, and it can be done. The data system that we were using to display the data county by county was in fact the system you referred to that the White House was also using. Once you enter data in that file, we entered the fire data, and we use the census data that is already in that computer to produce various kinds of maps showing the correlations between fire deaths and various kinds of census data and poverty and rural and so on. It can be done and you can compare these problems. There is high interrelation between them.

The whole point of the system we set up is to try to put things on that common basis. You need a common language for that.

So it can be done and we are on the way toward doing it, and one of the problems is even in the shady States, the States that are participating, there is not 100-percent participation. It is a voluntary system. You can't show the richness of data for every county like you can in deaths because they are not all participating, but we are hoping over time to get more and more participating so that you can get these bigger looks.

Mr. BROWN. Well, I don't think that the Congress has yet recognized the central importance of this whole problem, and one of the things that this committee may try to do is raise the consciousness of the Congress.

And in another committee, Government Operations, there is a major bill already proposed dealing with all government collected data which could include this, and which if it passes, I think it has a reasonably good chance, would completely restructure data collecting systems and try to rationalize it.

Now, the purpose of this is to decrease the burden and increase the quality of the data that the Government is involved in getting from whatever source, whether it is local government or health data or whatever.

And it is going to be a tremendous task. I think it is probably the only way we are going to get the voters off the back of the Federal Government for being an increasing burden in terms of paperwork. And this is why I bring up the question of rationalizing these data systems so that we can get the maximum utility with the most efficiency that it is possible to get with modern technology, that is just extremely important.

Mr. MACY. That is the heart of any emergency management system.

Mr. BROWN. Correct.

Mr. MACY. If you don't have the data, this is it.

Mr. BROWN. That is what I keep telling you.

Mr. MACY. As we said this morning, we want this to be one of our prime objectives of development in the agency and we want to work as closely with you as we possibly can.

Mr. BROWN. All right.

I'd like to go to another area, which is equally important in my opinion. I am not going to belabor this too much, but, Mr. Vickery, you have shown a keen sensitivity that you describe as getting the maximum public benefits for the substantial investment you have in the fire services, and you are acquainted with the problems of broadening the scope of fire service activities and using fire service personnel for a broader range of activities. You have indicated your interest in emergency medical services, and other things of that sort. I think I have discussed with you my experience in trying to combine police and fire under one safety director and the problems that arise as a result of that, which is an indication of some of the institutional, I guess, problems that when you try and disrupt long standing and traditional arrangements, but the importance of doing what you suggest, that is, getting greater use from our investment in fire service lease to a number of areas, the question of more efficient management of fire service defining alternative career ladders, finding ways to use fire personenl who after serving 20 or 25 years in an arduous occupation, frequently are physically unable to perform that, and yet, because they have no attractive alternative other than to retire, became an undue burden to the pension system on the payroll.

There are, just speculating, many ways in which that could be corrected. The fire service personnel can be used not only for firefighting but for a range of public education, of fire prevention activities, of emergency medical service activities, an imaginative person such as yourself I am sure could think of career alternatives could use the skills developed over a career in firefighting to serve the public interest in which its not been done at the present time.

My question is a very simple one.

Do you see it as part of your role in the fire administration to think in broad planning terms of how to solve this problem, which means billions of dollars to the taxpayers of this country?

Mr. VICKERY. Absolutely.

I think it is probably hopefully based on my experience in municipal government in some rather strong ideas and plans on that subject that I personally want to direct a lot of my effort at the U.S. Fire Administration toward achieving some of the suggestions that you just made.

Fire departments are generally poorly manged, generally.

Mr. BROWN. There are probably some fire administrators in the audience, you better be careful.

Mr. VICKERY. They have been angry with me before. This won't be the first time, and I am willing to argue the point with them.

I have always opposed city administrators, mayors, whoever, who had the idea you should be selling dog licenses or that you should be painting streets or this sort of thing.

I think there is plenty to do for a fire department if it has realized the scope of its capability, and the problem in their own community and I like to use the term "full service," a full service department.

I like to use the term "saturation inspection." You can't inspect too much in a community. I am absolutely amazed that I can go into major cities in America and indicate how come your companies aren't out there today inspecting, why are they sitting in the fire station. The reply would be, "We are afraid if the fire engines are on the street it would excite people and they would think we are fighting a fire."

The police forces in America would give a billion dollars to have the same opportunity that a fire fighter has and the willingness of the public to accept this inspection, suggestions and recommendations that a fire department can make.

This requires something other than tradition. It requires effort. It requires good codes in the community. It requires an aggressive chief and a team that is willing to work to achieve essentially what you suggested.

This is being done in a few communities but not generally, and you have to recognize the fact that 80 percent of America's fire fighters are volunteers and are not working full time.

So I am addressing my remarks primarily toward jurisdictions or municipalities where you have full time fire departments.

There is no reason why some element of a fire department can't be inspecting 24 hours a day. There is no reason why every morning half your fire department could not be out on the street inspecting and the other half inspecting in the afternoon.

There is no reason why you can't have a public fire education program which encompasses not only the normal service clubs and things that involve your school, such as, "Learn Not To Burn."

There is absolutely no reason why part of your training cannot be dedicated toward enhancing the capability of police to work more cooperatively with the fire service.

One of the programs that Mr. Macy and I are formulating at the moment is how do we get fire chiefs and civil defense workers to work together in a more cooperative manner.

One of the great tragedies in America is we are not utilizing our fire departments to the extent that we should in emergency medical service. Here you have a person who is tenured in some cases as you mentioned they may have some disability preventing going up a hundred foot ladder, but they could serve effectively in the emergency medical service system.

You have a person that is tenured, you have capitalized his equipment, radio and vehicle, you have a built-in training mechanism. Any good fire department has an excellent training program in which you can plug in the EMS with no problem whatsoever.

I can't understand in my own mind the existence that is occurring in the fire service in America and I speak to it every day.

They are missing a golden opportunity to prove to their community that their investment was a wise investment and they are no longer a part-time department, they are a full service department.

Mr. BROWN. Well, you mentioned yourself the role of the fire department, fire service in connection with other types of emergencies. The first one that comes to my mind in California is flood.

The fire department is one of the first to be out there in a critical flood condition. There are chemical spills. There are radiological accidents. There is a whole range of emergencies that can occur in which the fire service is the logical, you might almost say command, organization to cope with that.

But I have the feeling, and I may not be completely correct, but there isn't this breadth of emphasis given to the importance to this broader emergency response role that I would like to see. And I would like to see it, of course, reflected in the more complete integration at the Federal level than all of these emergency services.

You don't differ with that; do you?

Mr. VICKERY. I don't differ with it at all and I think that is the path we are on in FEMA.

John Macy has been very supporting of my expressing essentially the same thoughts I expressed to you here and that you have expressed to me. I see this occurring in a manner that has never occurred before.

Can I give you another little exciting idea. This will be the first for Mr. Macy to know he has a part in this.

Mr. BROWN. You and I have a tendency to talk a little longer than we should.

Mr. VICKERY. OK. One more comment.

Because this leads right in to what you are talking about.

There is a group within the International Association of Fire Chiefs called the Metropolitan Chiefs. They represent areas of 200,000 or more jurisdictions.

We are going into Tucson in April to meet with them. Mr. Macy will be speaking and I will be there. Instead of a review of what we have done in the past year, we are going to present six challenging areas to these 100 chiefs that represent the largest jurisdictions in America.

If it happens in those jurisdictions it will probably happen in rural areas. The six subjects we are going to talk about down there, No. 1 will be interchange of fire fighters. Why shouldn't a fire fighter in Seattle go to Miami for 1 or 2 years on an interchange program?

Another one will be emergency medical service.

Another one will be how do you get along with FEMA. How do we maximize fire departments in the Federal Emergency Management Agency.

Others will be women in the fire service and hazardous materials.

And one that I think is novel, I want to approach them with the idea of if we have some good ideas in the United States that are working and we have five or six chiefs that are really interested in making those programs work. As the new chief, and we happen to have one in Seattle as of this morning, could call the U.S. Fire Administration in FEMA and say, "I have five people here with modular programs that are willing to come in with senior fire chiefs to your community and show you as a new chief how you could make these programs work in your community that have worked in those five others." I would hope that Mr. Macy would chair the how FEMA could get along with the municipal.

Mr. MACY. I will be there.

Mr. BROWN. I am sure, Mr. Macy, is unable to refuse this. We are approaching an area of a couple of matters of a broader nature we neglected to pursue some details which I would like to have in the record to complete it.

I think the staff would like to have you supply Mr. Vickery, some details as to how you would distribute the program funding for, say, an increased arson program, at least a public education program, some of the things you have raised so as to what would be your priorities if we were to seek to increase the authorization for the Fire Administration. I am not at all guaranteeing that we will, but we would like to know what your priorities might be in these areas. You can do that for the record.

Mr. VICKERY. Yes sir.

Mr. BROWN. Mr. Scoville.

Mr. SCOVILLE. I have one brief technical question.

Can you tell me how much money is there actually in the President's budget for the annual arson effort at this point?

Mr. VICKERY. Richard Strother, who heads up the Office of Planning and Education will respond.

Mr. STROTHER. Within the President's budget is $673,000 for the Fire Administration.

A Fire Administration. Approximately $9 million in the LEAA and then amounts in FBI and ATF.

Mr. SCOVILLE. Only $673,000 in the U.S. Fire Administration?

Mr. STROTHER. That is correct.

Mr. SCOVILLE. I think last year we authorized $5 million?

Mr. STROTHER. $5.4 million.

Mr. SCOVILLE. Thank you, Mr. Chairman.

Mr. BROWN. Another thing we are interested in the degree in which you coordinate your planning for in areas such as fire research where there is a certain amount of pass-through money to the National Bureau of Standards.

We are interested in the impact of this both on your program and the National Bureau of Standards and I want to ask you to what degree—do you sit down with the Bureau and look at this in terms of longer than 1 year, and consider your needs and their needs, in other words, how effective is both the coordination and the planning that you do specifically on the fire research program as it involves the Bureau?

Mr. VICKERY. I would like to make a brief comment and have Phil Shaenman comment because it is within his program area.

I would say it is working much better than it was a year ago.

There were substantial frictions as the budgets moved through Commerce. Let's be candid, people were not all happy. They weren't speaking to each other as well as they should have. I think that is all ended, and Mr. Schaenman elaborate a little bit and if necessary, Dr. Clark, too, who is here from the Center for Fire Research.

Mr. **Schaenman.** We have been working very closely with the Center for Fire Research on many programs. In fact, funds have flowed both ways when they have wanted our help on something and we wanted their help on something, both in the data collection side, on development of sprinkler systems, and on evaluation of smoke detectors. In many areas there has been very close day-to-day working relationships.

Also, long-range planning on what do we see in the next year or two in areas like sprinklers or smoke detectors or even data analysis.

I think there has been a very excellent coordination between the two.

Mr. **Brown.** You haven't progressed so far as to have a formal multiyear plan?

Mr. **Vickery.** Five-year.

Mr. **Brown.** You do have.

Mr. **Schaenman.** In fact in the formulation of this fiscal 1981 budget, the Director of the Center for Fire Research sat with the Associate Administrator and Deputy Administrator of the U.S. Fire Administration in deciding on priorities for both of our budgets. We all work together in those priorities.

Mr. **Brown.** If you have such a formal planning document, even though it may not be administratively approved by the President or anything, I wonder if you could supply it to us?

Mr. **Vickery.** Surely.

One thing I might add at the end, there is a new program that we are starting with a Dr. Clark serving as science advisor to me personally. When I came to the U.S. Fire Administration, we had a research group with a science adviser. I did not like the way it was functioning. It was moved to Mr. Schaenman's program and in turn I lost my science adviser. So in addition to the normal cooperation we get between the two, 1 day a week of Dr. Clark's time is dedicated to advising me personally on how we relate not only to them, but to the rest of the fire research programs within the Federal Government.

Mr. **Brown.** Gentlemen, I am going to do a little peculiar thing.

I have to go vote on this measure, and Mr. Scoville has some questions. And I am going to ask you to respond to his questions, and then when he finishes, we will excuse you and as soon as I get back we will take the next panel of fire administrators. If that is satisfactory to you.

Mr. **Vickery.** Thank you very much.

Mr. **Scoville.** Mr. Vickery or Mr. Macy, whoever else I guess would also like to get Mr. Macy's response to this, given the disparity between the funds that were authorized last year of $5 million for the antiarson effort and $673,000 which is in fact requested in the President's budget, this is for the USFA funds, can you tell us why the President chose not to request a higher sum? That is substantially level funding, if I remember correctly, even below level funding for the USFA component on the antiarson?

Mr. **Vickery.** I don't know.

Mr. **Scoville.** Is there a reason why?

Mr. MACY. I don't recall that the issue was ever raised during the course of the budgeting process. We will look into that and give you a statement to that effect.

Mr. SCOVILLE. There has been a lot of interest on the part of the members in the past years on antiarson efforts, and the question is, should the members decide they wish to increase it, we would like to know whether this is a favorable thing or not, if it is why, if it isn't, why?

Mr. MACY. My speculation, Mr. Scoville, is that what happened is that the budget process started at a point and got to a decision prior to the development of the aggressive program that we were discussing. So that in some way it reflects an earlier position and not one that we had advanced since them.

Mr. SCOVILLE. There is only one problem with that, at least which is basically the overall program recommendations were informally known and reflected in our last year's committee report almost—well, 1 year ago, just about 1 year ago now, and the formal report was submitted albeit a little bit later than originally called for, nevertheless in the spring, and that is well before the—well within the budgeting cycle to allow this sort of a request, or at least some matching of the—this is coming out of your own recommendation.

I guess we'd like to know why the administration has chosen not to follow its own programmatic recommendations, you see as far as actually backing up the recommendations with funding, so if you could supply that for the record so we could at least decide——

Mr. MACY. We will give you what explanation we have.

Mr. SCOVILLE. That will be of great help.

Dr. ZIMAN. I have one question.

You addressed the problem of integration of fire and other emergencies.

One of the things that you haven't addressed yet or at least I haven't heard is with regard to both FEMA and U.S. Fire Administration and the emergencies and disasters you can get with forest fires.

What can be done in that area? This is a large problem in the West and a problem in other places?

Mr. VICKERY. There are a number of things that are occurring.

Again not by way of excuse but by way of explanation, the entire U.S. Fire Administration including the janitor and all of the academy totals 141 people.

One person is dedicated to Federal coordination of programs such as that. We do work and meet regularly with the wild lands people who are involved in that firefighting problem. We do include them in our data system. We do participate in their educational programs. We are encouraging their people to attend the Academy. They will be participating in the classes at the Academy. Those are some examples of what we are doing in the U.S. Fire Administration.

We do within FEMA have an individual who is interested in foreign agreements as to whatever they might be. We are at the present time negotiating with Canada, primarily British Columbia which reaches down and over Montana. We can have an agreement with that Province and three States that border to be able to move firefighting equipment back and forth.

So it is being addressed rather aggressively.

We are also preparing a 5-year program for the total Federal fire effort.

There are about 29,000 Federal firefighters, I would say it is very extensive.

I would say our total dedication is one man in a planning and monitoring mode.

Mr. **Macy.** In addition to that, it is important in looking at the total FEMA picture to recognize that there is under the disaster relief act an obligation on the part of FEMA to dial with fire suppression activities in the forest fire area, and this is another point of coordination with the Fire Administration.

Dr. **Ziman.** Do you see an increase in the next year? You say one person how. Are you going to try to increase this effort?

Mr. **Vickery.** I have assigned an Intergovernmental Personnel Act person to Mr. Hanbury in an effort to expedite some of the programs in that area. We would hope that we would be able to expend some additional effort.

Mr. **Scoville.** I keep thinking of more questions.

I was interested, Mr. Vickery, your comment about this Operation Dixieland which you were thinking of mounting, it struck me over the several years I have been dealing with this authorization of the disparity between the resources that were originally called for. I think a $100 million——

Mr. **Vickery.** $110.

Mr. **Scoville.** The initial report of your Agency and the actual funds granted to the Agency which are more like bearing between $12 and $20 million, and at the same time there is a GAO study of about a year and a half ago which suggests the fire program would have a hard time making a measureable impact, just given the size of the effort and also what they put it was given the enormous breadth of activity that the Fire Administration was attempting to tackle.

So I guess I always felt perhaps some concentration on a small range of problems or small geographical area where you would really go in and show what you do, what you could do might be very helpful in getting a program going on further and really showing what techniques works, what techniques do not work, so could you for in time for our committee report perhaps provide us with a more detailed description of your Operation Dixieland, how you would propose—what sort of magnitude of funding would this be, so that we can get a feel whether this would be something we should encourage you or not, because I think there is this real problem of how do you mount enough of an effort on one problem to be able to actually get a measurable result on it. So you can comment on it here, fine, but we also would like to have, perhaps, a little better description.

Mr. **Vickery.** We have done some homework on that and I would prefer to submit it to you in writing.

Mr. **Scoville.** That is fine. If we could get something done even if it is fairly broad so we could consider the concept as we go to write up the report for this authorization since it affects your activities over the coming year.

Mr. **Macy.** This is why it is necessary to apply certain standards of impact in selecting what over a broad range of challenges face the fire service.

I think some of the points that Mr. Vickery has made can be traceable back to either a demonstration or attacking a particular acute problem or having a high degree of transferability once the effort has been made.

So we are really trying to get the kind of leverage that he has identified, which magnifies the impact of the resources that are being invested.

Mr. **Scoville.** Maybe also if you are able to focus enough, attack enough dimensions of the fire problem in one concentrated area, you got a synergistic effect between just a heightened awareness of the programs and will contribute to the public education component which is obviously tremendously important.

Mr. **Vickery.** I am sure there are all kinds of peripheral benefits which we have not even envisioned. I think some things are going to come out of this as you are suggesting that we don't even realize. Positive things.

Mr. **Scoville.** We would be very interested in hearing it.

Mr. **Macy.** There are difficult managerial choices because every one of these objectives that are identified looks as though it could have a payoff.

Mr. **Scoville.** The other thing that comes up the converse would be difficult for you to answer now which I hope to ask the fire service organizations who are going to be on next, which is that how would they react to this sort of an essentially concentration of resources, what would their feeling be about let's not try to paint with a broad brush for the next couple of years, really go in and hit one area hard and really try to show some dramatic results.

Mr. **Vickery.** We would hope and pray they would be part of this effort.

I don't know of anyone involved in the firefighting effort nationally that isn't seriously concerned about saving lives and reducing the number of fires, and I am sure they would be concerned and hopefully supportive.

Mr. **Scoville.** OK. Thank you.

We will wait until Mr. Brown comes back.

[A short recess was taken.]

Mr. **Brown.** The subcommittee will resume.

Mr. Vickery, last year, the legislation that we passed authorized a review of firefighter safety which was to include an analysis of effective protective garments, breathing equipment and so forth.

I wonder if you would care to comment in light of the demonstration we have here as to the progress to that program.

Mr. **Vickery.** Thank you, Mr. Chairman, this is one of our priority programs, not only because matters of human life are all important, but the fact that communities have to look at the investment they have in a firefighter and the potential they have for a pension. We have a project called Project FIRES in which we are addressing protective garments for firefighters and the present equipment is certainly not adequate. It has not kept pace with technology, and so Phil Schaenman has done research. He has with him a gentleman who is wearing a product that will be field tested here very shortly.

Mr. **Schaenman.** We owe you a report on firefighter safety and health. A report to Congress and you will get it the end of March.

We want to show you a visual report. Andy Sears, is the project manager of this project. This is the first prototype of a new firefighter protective outfit. This has been in development for about 3 years with an advisory group from the local fire service nationwide. This is the actual development of a new outfit developed by Grumman Aircraft in cooperation with NASA.

It has a couple of really outstanding new features.

First of all, it is about 40 percent or 8 pounds lighter weight than the existing protective outfit.

Second, perhaps most importantly, all the parts of the outfit are integrated so that the boots attach to the pants cuff. The sleeve has a wristlet that goes under the glove so that when you extend your arm it protects against wrist burns. The jacket has a detachable hood that comes in two weights for different areas of the country and different weather. The hood is like a racing driver's hood that protects against head and neck burns. The helmet has a visor that retracks. It protects against scuffs and getting dirty. This particular outfit has actually been going through lab tests the last several weeks and later this spring we are hoping to go into field tests in about 10 cities across the country. The cost of this outfit is slightly more than the existing outfits. But it is about the same cost as a suit and pair of shoes today.

Mr. BROWN. Well, it certainly appears to meet the needs of the service. Being an amateur, I can't determine how effective it is. It is striking in appearance. I will look forward to seeing it; reminded me of a pilots uniform.

Thank you very much.

Gentlemen, we very much appreciate your willingness to persevere as long as you have this morning and this afternoon, and I think this has been a very productive discussion of our mutual concerns and effort in this area, and we want to express our appreciation to you.

Mr. MACY. Thank you, Mr. Chairman.

Mr. VICKERY. Thank you.

Mr. BROWN. Now, I will call the representatives of the joint counsel of fire service organizations, and I suppose we have provision for all of them.

We welcome you all.

Are you going to be the moderator.

Mr. REDDEN. Yes, Mr. Chairman.

## STATEMENT OF JOSEPH M. REDDEN, ASSISTANT VICE PRESIDENT, PUBLIC PROTECTION, NATIONAL FIRE PROTECTION ASSOCIATION

Mr. REDDEN. Mr. Chairman, I am Joseph Redden, assistant vice president for public protection, for the National Fire Protection Association, and also secretary-treasurer of the Joint Council of National Fire Service Organizations.

David Floyd the president of the black professional firefighters and chairman of the joint council was due to moderate this group today, but David is also a lieutenant on a New York Fire Department. He was down with us earlier today, but he had to get an early plane back because he must be to work tonight.

So I am filling in for Mr. Floyd and I would like to read statement.

Mr. Brown. Would you express our regrets that he couldn't be here today. We would have enjoyed hearing from him.

Mr. Redden. Yes, sir, I certainly will.

The joint council is composed of the following organizations: The Fire Marshals Association of North America, International Association of Arson Investigators, the International Association of Fire Chiefs, the International Association of Fire Fighters, the International Fire Service Training Association, International Municipal Signal Association, International Society of Fire Service Instructors, Metropolitan Committee of the International Association of Fire Chiefs, the National Fire Protection Association, the International Association of Black Professional Fire Fighters, and the National Association of Fire Science Administration.

I wish to thank you, Mr. Chairman, on behalf of the joint council for inviting us to testify today on this requthorization hearing of the U.S. Fire Administration.

Four members of the joint council are with me at this hearing, and I would ask them in turn to identify themselves and also to identify their organizations as they speak.

Before my colleagues do make their statements, though, I would like to state that the joint council as a body is strongly supportive of the U.S. Fire Administration, and believe that the current direction being taken is an effective attempt to deal with the fire problem.

We have watched the transfer of the Fire Administration from the Department of Commerce to the Federal Emergency Management Agency with some concern.

Having come to a very clear agreement with the White House staff during the planning stages of the reorganization that the identity and function of the U.S. Fire Administration would not be diminished nor otherwise lost in this new agency.

We hold that point of view today as strongly as we did at the time of the transfer, and would ask this committee to watch this aspect most clearly should it develop.

Again, Mr. Chairman, the joint council as a body supports the direction taken by the U.S. Fire Administration and recommends reauthorization.

Mr. Brown. All right.

We appreciate that statement, Mr. Redden, on behalf of Mr. Floyd.

I think you know and all of you gentlemen know that to a very large degree you bear some responsibility for the creation of the U.S. Fire Administration and providing solid base of political support for it.

Sometimes it is influential here in the Congress and we are pleased that you could make this statement, Mr. Redden, on behalf of Mr. Floyd and you could be here to present it for him and we look forward to hearing from the other gentlemen.

## STATEMENT OF HAROLD A. SCHAITBERGER, INTERNATIONAL ASSOCIATION OF FIREFIGHTERS

Mr. Schaitberger. Mr. Chairman, I am Harold Schaitberger, and I am legislative director of the International Association of Firefighters, AFL-CIO-CLC, representing approximately 175,000 professional firefighters throughout the United States and Canada.

Before the statement, I would like to first extend the apologies of our general president, William Howard McClennan, who intended to be here today to present this statement to you, but was held in Florida during the AFL–CIO Council session, slightly longer than he originally anticipated.

Additionally, I would like to take this time to introduce Mr. Dave McCormick, who has joined me today, who is now the assistant on technical and professional matters to our international union, and who previously served as the superintendent of the U.S. Fire Academy, and U.S. Fire Administration.

I am pleased to appear before the subcommittee today to express our views on the fiscal year 1981 reauthorization for the U.S. Fire Administration.

In 1969 the Federal Government first indicated its interest in the serious national problem of fire by enacting legislation which established the National Commission on Fire Prevention and Control. Our president, Howard McClennan, had the great privilege of serving as vice chairman on that Commission. The experiences and observations that we made in the course of working with the Commission both complemented and butressed the views we had gained from our professional firefighting work. The facts at that time all led to one conclusion—that we needed Federal leadership and assistance if we were to keep fire prevention and control abreast of modern demands on the fire services. With the United States experiencing one of the highest rates of fire deaths and property loss among all industrial nations, that need continues to exist today.

To deal with the magnitude of losses in life and property experienced in this country, the Congress, through the National Fire Prevention and Control Act of 1974, envisioned a comprehensive Federal program, working in cooperation with and in support of State and local officials. In response to its legislative mandate, the U.S. Fire Administration has had three main program directions: Education and training, a national fire data center, and research and development in fire sciences and engineering.

Last year, significant strides were made in the area of education and training with the purchase and opening of the National Fire Academy in Emmitsburg, Md. The establishment of a National Fire Academy has long been one of the major goals of IAFF. The Academy with resident capacity of 300–500 students and space to accommodate conferences up to 1,000 people, will serve as a focal point for upgrading firefighting capacities throughout the country. Selected individuals representing firefighters, fire chiefs and marshals, code enforcement organizations, architects, arson detection units, and other fire-related professionals will be trained in the most advanced techniques of firefighting prevention and control. These experts will then share this information, passing their knowledge on to colleagues throughout the country. The IAFF is gratified to see the National Fire Academy finally established and opened for operations. With its establishment the U.S. Fire Administration can now hope to make the major strides in the education and training of fire-related personnel needed to significantly reduce fire deaths, injuries, and property losses in the United States. Funds sufficient for meeting these goals must be authorized.

One program within the area of education and training in which the IAFF takes a particular interest is the open learning fire service program. The program is a higher educational project which provides access to higher education to all fire service personnel in the country. The project is run in conjunction with selected institutions of higher education, offering a quality education to students and awarding credits and college degrees in fire science and fire administration programs. Since its inception in 1977, the program has been highly successful in attaining its stated goals, and has done so in a most cost-efficient manner. We, therefore, feel that funding should be provided for its continuation and request that the subcommittee include specific funding recommendations for the program.

While the U.S. Fire Administration has been working to make advances in the area of public education, an appalling lack of knowledge and awareness of the seriousness of the national fire problem continues to exist. Authorizations for the continuation of these efforts should be made, so that the public can take an active part in the alleviation of this Nation's fire problem.

In our view, research and development is one of the most important programmatic areas within the U.S. Fire Administration. As you are aware, firefighting is the country's most hazardous occupation, with the highest line-of-duty death and injury rates. The USFA has been moving toward a scientific analysis and study of measures for the reduction of firefighter death and injury rates. The firefighters' integrated response equipment system project, conducted in cooperation with NASA, is an example of the progress that has been made in this area of research.

Nonetheless, we must stress the absolute necessity of funding not only for the continuation, but also for the expansion, or firefighter occupational safety and health programs and the development and evaluation of safety equipment, if the unacceptable death and injury rates among firefighters are to be reduced.

Another area of research which we believe paramount to the improvement of fire protection delivery systems in this country is the study of the numbers of personnel assigned to engine and truck companies, in order to determine safe and appropriate manning levels.

In last year's authorization, the Congress included significant funds for assisting State and local governments in the fight against arson. In light of the continuing epidemic proportion of the crime of arson in this country today, we would hope that this subcommittee will continue to support those programs, so that the fight against arson may finally be won.

While we have emphasized only some of the programs within the U.S. Fire Administration in our testimony today, we are not suggesting a lack of support for the continuation of its various other programs, among them the National Fire Data Center, the Center for Fire Research within the National Bureau of Standards, and smoke detector and sprinkler systems studies.

Overall, we are in support of the U.S. Fire Administration request for fiscal year 1981 as presented to you today.

This authorization level is the absolute minimum essential if the Federal fire program is to significantly reduce the losses in life and property due to fire in this Nation.

I would like to thank the subcommittee for this opportunity to express my views on behalf of the international and its members, and would be willing to answer any questions after the panel has concluded.

Mr. BROWN. Thank you very much, Mr. Schaitberger.

I think your statement is a very valuable contribution to the record.

One of the things that we are always fearful about in enacting a new program, it will diminish the feeling of responsibility at the local level for the successful carrying out of the activities they have been engaged in.

It would be regrettable if that were to happen in the fire service which is why I emphasize with Mr. Vickery the importance of the philosophy that the fire service is to aid and improving the activities at the local level, that includes including their levels of professionalism, their ability to manage local fire and related types of problems, and broadening of their concept which you have commented on of involving the community to community education in the reduction of fire and losses.

In the police field, its been found time and time again that the most effective law enforcement is that in which the community is involved, and certain to reduce the causes of crime and the opportunity for crime.

The same is true in the fire field. But this does lay a heavier burden sometimes on the local forces, and the whole role of the Fire Administration, is to help them assume that burden and not to replace them.

I hope that you would agree.

Mr. SCHAITBERGER. I think the Fire Administration to date has been fairly successful in augmenting and not supplanting the responsibilities of the control of fire services in this Nation.

I think its direction is more important and hopefully it will—the direction is taken and will continue to be a support service to local and municipal governments rather than try to supplant or control its activities.

Mr BROWN. All right.

Shall we continue then?

## STATEMENT OF MARTIN GRIMES, NATIONAL FIRE PROTECTION ASSOCIATION

Mr. GRIMES. My name is Martin Grimes. I am substituting for Robert Grant, president of the National Fire Protection Association who was unable to attend today.

I am presenting a paper just to confuse you which is labeled "Presented by Joseph Redden." It is the one here, just to be sure we are on the right track here, with your permission, sir, I would to just ad lib through the paper rather than read it all the way through.

Mr. BROWN. The full text will be included in the record and you may present it as you wish.

Mr. GRIMES. The National Fire Protection Association has, as you mentioned earlier, in concert with the other organizations of the joint council, supported the establishment of the U.S. Fire Administration and its programs.

As you may recall, 2 years ago we became rather critical of those programs, and we suggested some changes in direction.

Last year, we were more optimistic because of the appointment of Mr. Vickery.

I would like to go into this with further optimism and on much more positive basis in that we see that direction of the U.S. Fire Administration going in the way we had recommended earlier some 2 years ago, and we think that the direction now being established is probably the correct one for the U.S. Fire Administration.

I make that point because I think we have at times criticized and I would like to understand we don't always criticize, sometimes we support something when we see it going in the right direction. That is the way we feel about the Fire Administration right now.

We have seen some developments, of course, which have already been mentioned, without going into detail, we think the National Fire Academy is probably the most significant program of the Fire Administration in the long run.

In effect, over the years, this should reduce the fire problem by its multiplier effect and increasing the professionalism not only of the fire services but other practitioners in the fire prevention field.

We see the coordination being offered by the U.S. Fire Administration in the arson problem as being very productive.

We think also that the firefighter safety program is an absolute necessity, and that the direction now being taken is the correct direction for this program.

Last year when you asked for priorities, we suggested studies of manpower or utilization in fire departments, particularly critical today under the fiscal problem of the municipalities.

The U.S. Fire Administration is working in this direction with a very down to Earth proposal for a study of the manpower utilization which we think is very important, and the other priority we suggested last year was increased emphasis on the residential fire problem. We see that program going along very well, in the right direction, and it augers well for the future of that program. Nothing can be achieved overnight and we didn't expect a transformation in the Fire Administration immediately, but we are certainly more than pleased with the changes made in the last 18 months with the Fire Administration.

Two of the points that we raised 2 years ago was that there didn't appear to be much inclination on the part of the Fire Administration to use existing organizations. That has changed. We see a very much increased use of use of existing organizations in achieving the program results.

We think that was most important.

And we see that priorities have been established, in a somewhat pragmatic way to solving the fire problem. We think this is important because apart from the long term, there are short-term problems to be covered.

So in all we support, and we think the direction being taken by, Mr. Vickery and the U.S. Fire Administration in FEMA to be a highly satisfactory one.

It would be remiss of me not to mention the Center for Fire Research at the National Bureau of Standards.

Our organization is made up of 33,000 people drawn from practitioners of fire protection, not only fire service, but also architects, engineers, people from industry and other groups, all of which are involved in fire protection.

Some 9,000 of our members are from the fire service.

We produce some 200 codes and standards relating to fire safety, ranging from the standards for sprinkler installation right through to the professional qualifications for the fire service.

We do this under a consensus system with a lot of actors, a lot of people involved.

The National Bureau of Standards Center for Fire Research program is a very major contributor to the technology being incorporated into those standards, and we like to feel that this is recognized by your committee, that the Bureau of Standards fire research program is an extremely useful program of fire research and very necessary to solving the problem in the long run.

And with that, I'd like to close and pass on to my colleagues.

Mr. Brown. Thank you very much, Mr. Grimes.

[The complete prepared statement of Mr. Martin Grimes is as follows:]

## Statement of Mr. Martin Grimes, National Fire Protection Association

The National Fire Protection Association supported the original establishment of the U.S. Fire Administration, and the principles of having a Federal focus on fire. We remain convinced that there is a continuing need for this Agency.

In previous years, in our testimony before this subcommittee, we expressed a number of concerns about the direction that the Fire Administration was taking, particularly in duplication of existing fire protection programs, and in an apparent failure to achieve the objectives of the Federal Fire Prevention and Control Act of 1974, in the cooperative spirit that those of us who worked to convince Congress of the need for the act had anticipated.

I raise this point now as I did last year before the subcommittee, because it would be inconsistent to speak in support of reauthorization of the U.S. Fire Administration without acknowledging past concerns and present optimism.

I testified last year that while we still held to the principles that led to our past expressions of concern, we had seen developments that gave us encouragement that a change in direction was occurring, not the least of which was the appointment of an Administrator in the person of Gordon Vickery who knows and dealt with the problems of fire, understood the complexity of the problem, and was aware and acquainted with agencies and organizations, both public and private, which had something worthwhile to contribute.

We felt Mr. Vickery's past record of accomplishment in the fire service and the public utility area, and his proven managerial and leadership qualities fitted him in a unique manner to manage a struggling new agency efficiently.

Nothing that has transpired during the past year has changed this feeling of encouragement, in fact, much has happened that reinforces this feeling. With this type of encouragement we can support wholeheartedly the U.S. Fire Administration's efforts to bring the Federal focus on fire into being using cost-effective programs directed at achievable objectives.

In our endorsement for reauthorization of the U.S. Fire Administration last year, we recommended that the following policies be applied to the administration's operations:

1. Maximum use be made of the organizations already in the field, taking advantage of the experience and ability that exists in that quarter. We felt that the efficient utilization of resources in both the public and private sectors could not only achieve significant reductions in loss of life and property from fire, but also accomplish it in a cost-effective manner.
2. Establishment of priorities by the U.S. Fire Administration in concert with other fire organizations that are directed toward the most effective solutions for specific and urgent problems.

I am happy to say that we have seen much evidence of the application of both of these policies during the past year. Mr. Vickery has completely opened up the lines of communication with all organizations with an interest in the fire problem, and has arranged meetings with the various organizations to discuss material concerns of interest, and a cooperative attack on the fire problem.

Last year, we did not address programmatic areas, because we felt that the new administrator, Gordon Vickery needed time to set his course of action. The one area that we felt obliged to bring to the subcommittee's attention was the continuing need for a national fire academy which had been floundering from the very outset. Before the year had ended, the national fire academy had been officially opened and dedicated, and the superintendent and the majority of his deputies had been recruited. On January 21 of this year, the first on campus class convened, and in early February the first academy class was graduated.

This accomplishment is indicative of the type of managerial and leadership ability that Mr. Vickery has brought to the U.S. Fire Administration.

Last year we were asked to submit to the subcommittee four or five high priority projects that the fire administration should concentrate on. We listed the following as projects which we considered to hold a priority status:

1. National fire academy;
2. Arson;
3. Fire fighter safety;
4. Manpower levels and utilization; and
5. Residential fire problem.

I have already referred to the successful opening of the national fire academy. The Fire Administration has coordinated the Federal focus on arson, and effectively focused national attention on the problem. The focus was demonstrated at a very successful National Conference on Arson earlier this year in New Orleans.

Strides are being made in fire fighters safety through project fires, and other fire administration programs. The Fire Administration is embarking on a three phase study of manpower levels in the fire service as they effect operational efficiency and fire fighter safety. The residential fire problem is being attacked on many fronts, such as smoke detector and residential sprinkler testing programs, and successful educational programs sponsored by the Office of Education and Planning.

We feel that in the short space of one year, there has been a turnaround in the approach taken by the Fire Administration in its attack on the fire problem. We are happy to recommend reauthorization of the U.S. Fire Administration.

## STATEMENT OF DONALD FLINN, GENERAL MANAGER, INTERNATIONAL ASSOCIATION OF FIRE CHIEFS

Mr. FLINN. Mr. Chairman, my name is Donald Flinn, and I am Donald Flinn preparing and presenting my own remarks, unlike some of my fellow panel members.

I am the general manager of the International Association of Fire Chiefs and I also served as the deputy chief of the Silver Spring Fire Department.

The IAFC founded in 1873, represents both paid and volunteer fire chiefs as well as industrial, military, and Federal chief fire officers.

I am going to extract some remarks, Mr. Chairman, and will submit the balance for the record.

Mr. BROWN. Without objection, it will appear in full in the record.

Mr. FLINN. Thank you, sir.

The International Association of Fire Chiefs is dedicated to the advancement of community safety and the improvement of fire department management and administration.

I am pleased to appear before you today to support the reauthorization of the U.S. Fire Administration. I will address my comments to the needs and concerns of those responsible for providing and directing local fire prevention and control efforts.

The Nation's fire chiefs have had a long involvement with the U.S. Fire Administration and enthusiastically support its programs and efforts. However, we would be remiss if we did not point out that in 1973, the National Commission on Fire Prevention and Control, outlined a Federal program with an attainable goal of 5 percent a year reduction in deaths, injuries and property losses, with a leveling off at approximately one-half of todays losses. To do this, an estimated annual budget of $124,840,000 was required to address the Nations fire problem. However, the cumulative total for 6 years of the Fire Administration's budget is approximately 60 percent of that figure. Yes, the estimate property loss from fire in 1973 was approximately $2.7 billion; estimated property loss in 1978 had soared a staggering $4.5 billion. The total indirect fire loss, fire department operations, burn injury treatment, operating cost of the insurance industry, and productivity loss is astronomical. If we are to have an impact on this fire loss, then the U.S. Fire Administration must receive the necessary funding authorization.

In terms of programmatic initiatives, the Commission's report "American Burning" should serve as a guideline for the Fire Administration. The members of the Commission were recognized by the fire service community; they have identified problems and recommended solutions to the Nation's fire problems.

The members of the International Association of Fire Chiefs believe that the U.S. Fire Administration should be funded to assist and supplement local efforts for fire prevention and control. The U.S. Fire Administration must assist the fire service by providing the technical and financial assistance to help us to do our job more effectively.

To date, the efforts of the U.S. Fire Administration, under the leadership of Gordon Vickery, have been well received and supported by the Nation's fire chiefs. Mr. Vickery has done an excellent job, following the transfer of the U.S. Fire Administration from the Department of Commerce into the Federal Emergency Management Agency. Further, the IAFC supports the leadership of Mr. John Macy and feels that the U.S. Fire Administration will prosper in FEMA.

Moving forward to some other program issues which are very important, Mr. Chairman, and I will address these in greater detail in the written comments on emergency medical services, injury level, testing of fire personnel and hazardous materials.

The U.S. Fire Administration is in a unique position to serve as a coordinating agency between the Federal Government and the local first responders, the fire service. In addition, the National Fire Academy could develop the specialized courses that are needed to train fire officers the decisionmaking process to handle hazardous materials incidents.

Clearly, these are only a few of our concerns. We do feel, however, that the programs initiated by the U.S. Fire Administration, whether they involve research, data analysis, or fire safety education activities, have been in the best interests of the Nation's fire service.

The membership of the IAFC is pleased that Mr. Vickery has been responsive to the needs of his constituency, the Nation's fire service. We believe, that for the U.S. Fire Administration to be successful, it is essential that all constituents of the fire service have input into the programs of the administration.

The International Association of Fire Chiefs strongly endorses the reauthorization of the U.S. Fire Administration to an adequate level of funding to enable them to assist the Nation's fire service in solving the fire problems at the local level.

Thank you, sir, for allowing me to testify before your subcommittee.

[The complete prepared statement of Mr. Donald D. Flinn is as follows:]

Mr. Chairman:

My name is Donald D. Flinn, General Manager of the International Association of Fire Chiefs. The IAFC, founded in 1873, represents both paid and volunteer fire chiefs, as well as industrial, military, and federal chief fire officers.

The International Association of Fire Chiefs is dedicated to the advancement of community safety and the improvement of fire department management and administration.

I am pleased to appear before you today to support the reauthorization of the United States Fire Administration. I will address my comments to the needs and concerns of those responsible for providing and directing local fire prevention and control efforts.

The nation's fire chiefs have had a long involvement with the United States Fire Administration and enthusiastically support its programs and efforts. However, we would be remiss if we did not point out that in 1973, the National Commission on Fire Prevention and Control, outlined a federal program with an attainable goal of 5 percent a year reduction in deaths, injuries and property losses, with a leveling off at approximately one-half of todays losses. To do this, an estimated annual budget of $124,840,000 was required to address the nations fire problem. However, the cumulative total for six years of the Fire Administration's budget is approximately 60 percent of that figure. Yet, the estimated property loss from fire in 1973 was approximately 2.7 billion dollars; estimated property loss in 1978 was a staggering $4,478,929,183. The total indirect fire loss, fire department operations, burn injury treatment, operating cost of the insurance industry, and productivity loss is

ASTRONOMICAL. IF WE ARE TO HAVE AN IMPACT ON THIS FIRE LOSS, THEN THE U.S. FIRE ADMINISTRATION MUST RECEIVE THE NECESSARY FUNDING AUTHORIZATION.

IN TERMS OF PROGRAMATIC INITIATIVES, THE COMMISSION'S REPORT AMERICA BURNING SHOULD SERVE AS A GUIDELINE FOR THE FIRE ADMINISTRATION. THE MEMBERS OF THE COMMISSION WERE RECOGNIZED BY THE FIRE SERVICE COMMUNITY; THEY HAVE IDENTIFIED PROBLEMS AND RECOMMENDED SOLUTIONS TO THE NATION'S FIRE PROBLEMS.

THE MEMBERS OF THE INTERNATIONAL ASSOCIATION OF FIRE CHIEFS BELIEVE THAT THE U.S. FIRE ADMINISTRATION SHOULD BE FUNDED TO ASSIST AND SUPPLEMENT LOCAL EFFORTS FOR FIRE PREVENTION AND CONTROL. THE U.S. FIRE ADMINISTRATION MUST ASSIST THE FIRE SERVICE BY PROVIDING THE TECHNICAL AND FINANCIAL ASSISTANCE TO HELP US TO DO OUR JOB MORE EFFECTIVELY.

TO DATE, THE EFFORTS OF THE UNITED STATES FIRE ADMINISTRATION, UNDER THE LEADERSHIP OF GORDON VICKERY, HAVE BEEN WELL RECEIVED AND SUPPORTED BY THE NATION'S FIRE CHIEFS. MR. VICKERY HAS DONE AN EXCELLENT JOB, FOLLOWING THE TRANSFER OF THE U.S. FIRE ADMINISTRATION FROM THE DEPARTMENT OF COMMERCE INTO THE FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA). FURTHER, THE IAFC SUPPORTS THE LEADERSHIP OF MR. JOHN MACY AND FEELS THAT THE U.S. FIRE ADMINISTRATION WILL PROSPER IN FEMA.

IN TERMS OF PROGRAMATIC PRIORITIES, I WOULD LIKE TO ADDRESS A FEW ISSUES. THE FIRE SERVICE HAS BEEN, AND WILL CONTINUE TO BE, A PROVIDER OF EMERGENCY MEDICAL CARE AT THE BASIC AND ADVANCED LIFE SUPPORT LEVELS. WHILE THE DEPARTMENT OF TRANSPORTATION AND THE

Department of Health, Education and Welfare are involved with EMS, and we strongly support the U.S. Fire Administration's activities in this area. And, we believe that this is an appropriate issue for the U.S. Fire Administration.

To support this, allow me to site an example. In late 1978, the IAFC conducted a survey of our Metropolitan Fire Chiefs Committee, fire chiefs who serve populations in excess of 200,000 people. Of the 84 responses, 69 indicated they provided emergency medical services; these 69 fire departments serve a population of 51 million people. Another study, conducted by Fire Chief Magazine, found that some 17,000 fire departments provide emergency medical services. We believe it is appropriate for the U.S. Fire Administration to be involved with EMS issues. We also believe the U.S. Fire Administration should become more involved with the Interagency Task Force on EMS and take a leadership position within this group.

By the way, there has been some talk by the Department of Transportation to "explore the feasibility of recommending that EMS be established as a third emergency service" (police and fire being the other two), so that they can make recommendations to the U.S. Department of Transportation on future departmental policy regarding EMS. We are strongly opposed to the "third" service concept.

Another issue that has been plaguing fire department managers, is entry-level qualifications and testing, and promotions or career advancement. The Joint Council of National Fire Service Organizations has established a Standards of Professional Qualifications for the fire service. These standards cover the fire fighter, fire officer, apparatus driver, crash rescue specialist, fire inspector, fire instructor and fire safety education specialist.

THE U.S. FIRE ADMINISTRATION MUST ADDRESS THE ISSUE OF QUALIFICATIONS, TESTING PROCEDURES, PERFORMANCE OBJECTIVES AND PHYSICAL REQUIREMENTS AS THEY RELATE TO THE FIRE FIGHTING PROFESSION. BY SO DOING, THEY WOULD ALSO ADDRESS THE PROBLEMS FACED BY MINORITIES AND WOMEN, AS THEY SEEK CAREERS IN THE FIRE SERVICE. WE CAN NO LONGER IGNORE THE ISSUE, OR LET THE COURTS SOLVE THE PROBLEMS FOR US. THE U.S. FIRE ADMINISTRATION MUST DEVELOP GUIDELINES FOR THE IMPLEMENTATION OF VALIDATED, JOB-RELATED QUALIFICATIONS TO BE USED AT THE LOCAL LEVEL.

AN IMPORTANT ISSUE FACING FIRE CHIEFS IS THE ISSUE OF HAZARDOUS MATERIALS. THE CHEMICAL MANUFACTURERS ASSOCIATION HAS IDENTIFIED 18,000 MATERIALS AS BEING HAZARDOUS, WITH SOME 1,100 NEW MATERIALS EACH YEAR. THE FIRE SERVICE IS THE FIRST ON THE SCENE OF A HAZARDOUS MATERIALS INCIDENT, AND WE NEED HELP. THE IAFC WOULD LIKE TO SEE THE U.S. FIRE ADMINISTRATION SERVE AS A CENTRALIZED, COORDINATING AGENCY TO ASSIST THE FIRE SERVICE.

MUCH INVESTIGATION IS SPONSORED BY THE VARIOUS AGENCIES WITHIN DOT. THIS INFORMATION HAS GREAT APPLICABILITY TO OUR HAZARDOUS MATERIALS INCIDENT COMMANDERS. YET, THE INFORMATION RARELY IS DISSEMINATED TO THE FIELD. WE ARE THE ONES WHO CAN PUT THIS INFORMATION TO PRACTICAL USE AND WE NEVER FIND OUT ABOUT IT UNIT IT IS TOO LATE. MORE TECHNICAL INTERCHANGE WITH THE FIRE SERVICE ORGANIZATIONS AND FIRE SERVICE TECHNICAL JOURNALS IS NEEDED.

EACH MAJOR HAZARDOUS MATERIALS INCIDENT IS INVESTIGATED BY THE NATIONAL TRANSPORTATION SAFETY BOARD. FROM THEIR INVESTIGATION, A VERY WELL DOCUMENTED DISCUSSION OF THE INCIDENT, AS WELL AS A CAUSE OF THE ACCIDENT, IS PUBLISHED. THIS INFORMATION WOULD BE VERY VALUABLE TO FIRE SERVICE PERSONNEL. BY ANALYZING THE PAST SUCCESSES AND FAILURES, MUCH TRAINING INFORMATION CAN BE GAINED. THE FIRE SERVICE SHOULD HAVE A BETTER ACCESS TO THIS MATERIAL.

THE UNITED STATES FIRE ADMINISTRATION IS IN A UNIQUE POSITION TO SERVE AS A COORDINATING AGENCY BETWEEN THE FEDERAL GOVERNMENT AND THE LOCAL FIRST RESPONDERS, THE FIRE SERVICE. IN ADDITION, THE NATIONAL FIRE ACADEMY COULD DEVELOP THE SPECIALIZED COURSES THAT ARE NEEDED TO TRAIN FIRE OFFICERS THE DECISION MAKING PROCESS TO HANDLE HAZARDOUS MATERIALS INCIDENTS.

CLEARLY, THESE ARE ONLY A FEW OF OUR CONCERNS. WE DO FEEL, HOWEVER, THAT THE PROGRAMS INITIATED BY THE U.S. FIRE ADMINISTRATION, WHETHER THEY INVOLVE RESEARCH, DATA ANALYSIS, OR FIRE SAFETY EDUCATION ACTIVITIES, HAVE BEEN IN THE BEST INTERESTS OF THE NATION'S FIRE SERVICE.

THE MEMBERSHIP OF THE IAFC IS PLEASED THAT MR. VICKERY HAS BEEN RESPONSIVE TO THE NEEDS OF HIS CONSITUTENCY, THE NATION'S FIRE SERVICE. WE BELIEVE, THAT FOR THE U.S. FIRE ADMINISTRATION TO BE SUCCESSFUL, IT IS ESSENTIAL THAT ALL CONSTITUENTS OF THE FIRE SERVICE HAVE INPUT INTO THE PROGRAMS OF THE ADMINISTRATION.

THE INTERNATIONAL ASSOCIATION OF FIRE CHIEFS STRONGLY ENDORSES THE REAUTHORIZATION OF THE UNITED STATES FIRE ADMINISTRATION TO AN

ADEQUATE LEVEL OF FUNDING TO ENABLE THEM TO ASSIST THE NATION'S FIRE SERVICE IN SOLVING THE FIRE PROBLEMS AT THE LOCAL LEVEL.

THANK YOU FOR ALLOWING ME THIS OPPORTUNITY TO TESTIFY BEFORE YOUR COMMITTEE.

Mr. Brown. Thank you very much.

## STATEMENT OF LOUIS J. AMABILI, PRESIDENT, INTERNATIONAL SOCIETY OF FIRE SERVICE INSTRUCTORS

Mr. Amabili. My name is Louis J. Amabili of Dover, Del., director of the Delaware State Fire School. I am a former member of the National Commission on Fire Prevention and Control. I submit this testimony as president of the International Society of Fire Service Instructors on behalf of its nearly 3,000 members representing every State in the Union.

The society is a member organization of the Joint Council of National Fire Service Organizations and is recognized nationally as the voice of the Fire Service Instructor. In the interest of time, I will summarize my testimony.

I appreciate the opportunity to present testimony in support of the reauthorization of the U.S. Fire Administration.

It is clear, the Federal Fire Prevention and Control Act intends that the USFA should support, not supplant, the efforts of other fire-related agencies at the local, State, and national levels. Established and effective programs of both the private and public sectors should be utilized and not duplicated. Maximum utilization of existing resources can be both cost effective and efficient in combating the national fire problem.

The relationship between the USFA and the Fire Service improved measurably during the past year. Under the leadership of Administrator Gordon Vickery, the transfer from the Department of Commerce to the Federal Emergency Management Agency was accomplished in a most positive manner. The USFA also took a posture of listening and responding to the concerns and problems of its constituency. A conference for the representatives of the volunteer fire service was conducted in Snowmass, Colo. This landmark conference, known as the Stonebridge Conference, clearly identified the problems and needs of the volunteer fire service of this Nation. Similar conferences and meetings were conducted with the International Society of Fire Service Instructors, the Metropolitan Fire Chiefs, the International Association of Fire Fighters, the State Directors of Fire Service Training and others.

The area of major interest to the society is obviously the National Fire Academy.

The intent of the law is that the National Fire Academy support, not supplant, existing State and local training efforts and to assist in developing programs where they are nonexistent.

The society strongly supports the National Fire Academy as a central bricks and mortar facility, serving as the hub of a national training and education system. The existing State and local level training and education facilities can and must become an integral part of the National Fire Academy, thereby enhancing the quality of fire training and education throughout the country.

Perhaps the greatest achievement of the past year was the purchase and opening of the National Fire Academy. On October 8, 1979, the facility was officially dedicated. A new Superintendent assumed his duties on January 1, 1980. The Academy opened its doors to the first group of students on January 21. On February 1, 1980, nearly 7 years after the report "American Burning" was released, the first class of students graduated from this beautiful facility.

And I might add, Mr. Chairman, I had the privilege of being present, and I don't mind admitting publicly when the 75 students received their diploma, I had tears in my eyes, and it even kind of chokes me up now, because I thought I would never see it.

Since the inception of the National Fire Academy we have provided both solicited and voluntary advice on how the efforts of the National Fire Academy could be made easirer and better accepted by the fire training and education personnel of this Nation and the fire service itself.

We will continue in this effort by working very colsely with the National Fire Academy and providing advice and assistance whenever possible in achieving the goals outlined in "American Burning."

In other program areas, the society believes that quality fire data is important. If the data currently being collected is to be useful, it must be accurate. This accuracy can be enhanced through training courses and packages developed by the National Fire Academy for delivery through existing State training and education networks.

Research is no less important. We have not taken full advantage of available research data in the past. Future research efforts must emphasize applications useful to the fire service.

Among the many measures that can be taken to reduce fire losses, perhaps none is more important than educating people about fire. Public education about fire has been cited as the single activity with the greatest potential for reducing losses.

It will not be easy for people to be educated to the hazards which cause fires and what they can do to eliminate those hazards and how to react when their prevention efforts fail. However, the public's behavior must be modified to incorporate fire safety information into their lives as has been reading, writing, and arithmetic.

The programs outlined by the USFA for the fire service training and education, public education, research and data are complimentary programs essential to achieving our common objective, reducing the losses and costs attributable to fire.

Although the fire problem is primarily a local responsibility which must be dealt with at the local level by local people, we do need technical and financial assistance from the Federal Government. We are not seeking to have the Federal Government do the job for us. We are merely seeking to have the Federal Government provide us with a catalyst which will help us to be more effective in our work.

The USFA, during the past year, has clearly demonstrated the ability to be that much needed and essential catalyst.

We, therefore, urge that every consideration be given by your committee to authorizing an adequate level of funding to the USFA so that the programs of the various divisions may be adequately funded to help us at the local grassroots level better help ourselves in combating the national fire problem.

Thank you very much for the opportunity to present this testimony to your committee, Mr. Chairman.

Mr. BROWN. Thank you very much.

In thinking through again as we always have to do for justifications for a federally supported Fire Administration, I am led to think of the analogy which goes back almost a hundred years in our country, of our efforts in the field of agriculture where in the national interest we have supported national, Federal research and education activities which we call extension in the Department of Agriculture, and how we come to accept that as being the natural course of events. We have done this for many specialty areas, if you are watching the Olympics you can see that Cotton, Inc. sign occasionally.

Cotton, Inc., is federally chartered to engage in education and research and promotion on the merits of cotton.

There are literally dozens of such programs, so that you think of a supporting, an important program like the national fire education and research, through a central program of the sort we have, is not new or strange. It is in line with many other things that we have done, but we have to fight the battle over again every time we try and do something like that.

As a matter of fact, one of the central problems, it seems to be afflicting our total economy today, is the fact that we don't seem to recognize that we need to operate in a cooperative mode to solve national problems, even in industrial sectors and right now we are moving into, in this committee, we are discussing how to encourage cooperative research programs between important sectors of the American economy and research facilities in our universities and Federal Government for the national welfare.

And we see some signs that this is going to jell in the automobile industry, we are considering a program which makes Fire Administration look puny by comparison. For joint research with the oil industry on the geology of the ocean floor, and there is no commercial exploitation for oil. This is merely to understand the importance of knowledge, geological knowledge of the ocean floor.

I only mention this because I think we need to rethink the justification for these programs, and how it relates to national interest, and how we can operate in a cooperative mode without destroying certain basic values that we have emphasized here today of local control and local management of services.

I am happy to see that all of you have emphasized this aspect of the matter, and I hope you will continue to do that.

Now, I have a question I want to ask you gentlemen, ask all of you, if you have a contribution to make, there has been some reference to level of funding, and the comparison of present level of funding for the Fire Administration with that originally projected for a multiyear national program, and there is no real comparison. We are far below what was originally projected. And of course as was indicated it was our hope this national Fire Administration would lead to measurable reductions in fire losses, economic levels, so forth.

With the present level of effort it is doubtful if we would be able to say that we have—we will be able to point to the statistics and say we have reduced loss of lives and $4, $5 billion a year in economic losses, or at least we won't be able to see it for many years.

How would you gentlemen react to a program which called for whatever expansion that we can jell for this program, to be focused in an intensive way on a few demonstration areas around the country in an effort to demonstrate that a program at the level that was originally recommended really could reduce fire losses by a 25 percent, 50 percent, something like that?

We are not going to be able to increase the budget to $100 million a year. I guarantee you that.

But if we could increase it by $10 million and develop a demonstration of, say, a few metropolitan areas of what could be done, would that be a viable way or am I just whistling in the dark?

Would everybody be so jealous of the demonstration areas that they would say, "We don't want to see that sort of thing," would it have political problems? What do you think?

Mr. **Flinn.** May I answer, sir?

I have to answer in two parts.

One I think as a national, international organizations all of us could collectively agree that we at the national level would not be as jealous about those demonstration projects. However, as we all recognize, the facts of life of local government, I think there would be a very sincere competition for those demonstration projects for a variety of reasons.

However, all of us have supported, as Mr. Vickery has indicated in earlier testimony, a dedication to the saving of life and property from destruction from hostile fire. And I think we would all support those kinds of efforts.

The past practices and policies of the U.S. Fire Administration has been in creating demonstration projects and transferring that technology to other areas for their use of that information and technology, and I think we would certainly support that kind of an effort, provided, of course, that there is the collateral support in terms of the moneys available to do this, as opposed to taking away from existing programs and budgets.

Mr. **Brown.** Anyone else care to comment on that?

I am not at all asserting we would even be able to do this, although Mr. Vickery commented on this proposed Operation Dixie which was form of focusing in additional resourses on a given area where the problems are.

Mr. **Flinn.** We have all been very concerned about the fire death belt in the South and trying to identify ways to solve those problems in working with the staff at the data center, in other areas, how can we motivate these people to react to the problem we have identified or the U.S. Fire Administration has identified, and we just have exhausted organizationally our efforts at achieving good measurable goals in these efforts.

I think that if the Project Dixieland, or Operation Dixieland or whatever is the way to achieve the goal, I think we would all support it.

Mr. **Amabili.** I think what I heard you say, Mr. Chairman, was that we can't come up with $100 million like you ought to to do the job the way it ought to be done, but suggesting that some increase be added to the budget and go into the demonstration project to prove that programs can be effective which in the end result would justify additional dollars later on and certainly our group would support that wholeheartedly.

Mr. BROWN. I think you indicated, Mr. Flinn, that the original thought was this level of effort we could cut fire losses by a substantial percentage and it would amount to saving $1 billion or $2 billion a year, and obviously, that is a good investment, if you can save $2 billion by investing $100 million.

But I think the way we are going now, we are not going to be able to prove that. That is the point that I am concerned about.

Mr. FLINN. And we do recognize that, sir. We feel that by identifying as has been done with the information data center the roots and the specific causes of fire deaths and transferring that technolgy we hope to attain those goals by focusing on those fire problems that create fire deaths, whether education is the answer, residential fire safety programs, from the sprinklers or detectors, whatever it is, you can focus on those root causes. And there is obviously a skill in effect in terms of the increased population and so forth. We would work to that as a goal.

Mr. AMABILI. I also think going back as a commission that was one of the intents of establishing a fire administration to assist those areas that need the most help ought to get the most help as opposed to others that don't maybe need quite as much and it certainly makes sense.

And again, like I say, we would support it.

Mr. BROWN. All right.

Let me raise one other question that I think some of you have also referred to, the question of the broadened role of the fire service, as for example, the emergency medical service responsibility.

Would it be safe to say that you gentlemen would all agree that this is a legitimate area for the fire service to be concerned in, that you would share the view expressed there shouldn't be the establishment of a third emergency service separate just to handle the emergency medical service?

Mr. GRIMES. I would like to address one aspect of that, that obviously the provision of emergency medical service through a fire department makes sound economic sense under most conditions. However, one must be aware that the depletion of manpower in some of the principal cities in this country today means that the fire equipment is running undermanned, drastically undermanned, and that the imposition in some of those areas of additional responsibility by depleting the manpower from the firefighting forces, further could have quite serious effect, and I think basically the principle and conception of providing emergency medical services as an increase in productivity of the fire department and provision of better services is fine.

However, there are some problems in some of the major cities in the country.

Mr. BROWN. I can imagine some problems that would exist outside of the major cities, too, for example if we went to some sort of an emergency freeway service, you would have a problem where probably substantial areas in which there was no fire service jurisdiction and that would require some efforts different from the standard form of service.

But I am not thinking of the exceptional situation so much as I am the standard situation that would exist within most local jurisdictions.

Mr. Flinn. If I may, sir, IFC did a survey in late 1978 of our metropolitan fire chiefs and as the chairman has been—has had identified to him, the metropolitan fire chiefs are those communities that have the population of 200,000 or have 400 uniformed firefighters.

In that survey, the 84 departments that responded 69 of those 84 indicated that they provided emergency medical services, so the situation is there. The fire departments are providing this prehospital care. Those 69 fire departments serve a population of 51 million.

Mr. Brown. Well, if I can do a scientific survey of just television programs, it looks like the paramedics are getting more publicity than the regular fire service.

Mr. Flinn. That has always been our problem. We are just unattractive, in spite of the striking they are now presenting us.

Dr. Ziman. I'd like to just go back to one of the things you talked about, this was the other problem you have to address on a day-to-day basis, particularly hazardous materials, and the question of how to deal with them and how to handle with them on a local level. What provisions are you making for doing this now and are you involving or trying to involve some of the industry that are trying to manufacture these? I know, for instance, that there is CHEMTREK which is providing 10 regions and does provide services. But how well in reality are you able to respond to deal with this problem? What do you need to better deal with it?

Mr. Flinn. I don't want to dominate the panel.

Mr. Brown. You are a chief.

Mr. Flinn. Gordon, is that OK for him to say?

We are vitally interested, and have been for a number of years active in a variety of areas as have been other groups, societies have offered training programs in hazardous materials, identification and such and NFDA has a very active program including a variety of specialists that deal with just the various separate elements of hazardous materials, gases and such. We have been very concerned about this for a number of years and as an example of one of the legislative initiatives that might be anticipated has been that where we are encouraging the support in terms of resources provided and such of manufacturers of the products that we have to contend with in the transportation incident, for instance, there has been a reluctance on the part of many of these manufacturers to provide resources and assistance because of the liability factors they incur by providing this assistance.

It has been suggested by the chemical manufacturers association that there be consideration legislatively of establishing a Good Samaritan law which would reduce the opportunity of liability on the part of these manufacturers where they do respond to provide whatever resources they might have to mitigate or reduce the magnitude of the problem in a hazardous materials incident.

Other areas are in terms of some of the activities relating to investigative reports of the National Transportation Safety Board have indicated repeatedly that one of the major problems that takes place at these incidents is a lack of identification of the command incident commander, for a number of reasons.

No. 1, these people are very frequently in a rural area in a volunteer fire department, and frankly just have never received the kind of training to deal with the magnitude of the problem. Crescent City, Ill., was literally destroyed because of a variety of tank car explosions involving LP gas and you can go on and on with Waverly, Tenn., Clear View, Fla., and so on.

There need to be specialized programs of training to deal with hazardous materials, identification of these products, how to deal with the tremendous numbers of resources required.

I just had an opportunity of meeting with the fire chief in Canada who was directly involved with the evacuation of some quarter of a million people in Missessagua, Ontario, Canada, and he said, just one example of the magnitude of the problem you never think of in dealing with this kind of a situation, is those people were evacuated and out of their homes for a number of days, but there are family pets that were left behind, and there was a significant effort to go around on a regular basis and feed and water these pets, not only that, but you had to still maintain the security of the premises that they were occupying or going in to feed these pets.

Now, as the commander of a numerous series of incidents for some 25 years, the last thing I am going to think about is trying to feed a bunch of dogs and cats. Probably the SPCA is mad at me now, but that is the last thing I am going to be really concerned about, to be honest.

But some place you need to develop the kind of information to let the fire chief know or the incident chief know that there may be an item you are going to have to check off, some check list at some point in time. Have you fed the family dogs and cats? I can't feed my kids sometimes. They go through milk like its water.

Mr. **Brown**. You can order the SPCA to go in and feed them.

Mr. **Flinn**. That's right. But I have to know about that first.

Mr. **Grimes**. Can I address that also? The problem—you have to understand is that these hazardous incident materials are the aftereffect of an accident, defective road bed, and so on, and that is the root cause of most of the problem. Hazardous materials can be transported safely if those provisions are looked after.

So we often mistake the problem here, and I think that is very important.

But there are training programs available now. It is a matter of getting them well distributed, that were developed under contract with the Department of Transportation which are proving to have had some effect in some of the more recent accidents, the level of performance of the fire department in the emergency services has measurably, I say measurably, that is not correct, has increased. I can't say we can measure it, but certainly by observation, it appears that they are handling these incidents in a superior fashion to the way it was handled 5 or 6 years ago.

But we still have a problem with the product identification in those critical few minutes on the arrival of the first emergency services. That is still a problem. And that requires some action.

Mr. **Brown**. This is an important question.

I can easily call to mind a number of either hazardous material or hazardous event situations, leakage of hazardous gas from a tank car collision for example, these grain explosions down in Louisiana. Each of these represents a particular professional challenger, they are not typical of the ordinary fire alarm situations.

And the question I would have, of course is, do you feel that it is an appropriate role for the Fire Administration to develop the specialized training capability that could be in the form of prepackaged program of training materials and data that would be applicable to a wide variety of these new technological type hazards, that is, is it appropriate for the Fire Administration to be concerned with developing and disseminating these programs?

Mr. **Grimes**. The reply to the question, programs have been developed in the last 2 years under a Department of Transportation contract which are available, the U.S. Fire Administration's role would be to increase the dissemination of that information through its courses at the academy and its Outreach program, whether it be the DOT courses or similar courses.

I don't see any point in inventing two wheels to do the job when one would suffice.

Mr. **Brown**. Some place has to provide the networking capability, if the information is in transportation or Department of Energy, it may well be in certain kinds of, say, nuclear accidents or Department of Defense, even, there should be professional fire service personnel who know where to go and how to get the information that is necessary to handle the local emergency situation.

Mr. **Redden**. Mr. Chairman, If I may, in handling any emergency situation, it seems to me that the same thought process can and should be used that is used at handling a fire.

There are a set of factors involved, and there are certain activities that you as a fire ground commander must carry out to overcome these factors to arrive at an objective.

Now at a fire scene operation, the fire department arrives with all the tools and much of the knowledge that they need.

They can tell looking at a burning building in most instances and having some prior knowledge of the occupancy of the building, what is burning and the possible effect of that burning. The link that is missing with hazardous materials is that information on the material itself and how to assess the emergency nature and this is where I see the National Fire Academy coming in in utilizing programs that have been developed, and if they have not been developed, getting them developed so that fire ground commanders can assess the emergency nature regardless of what their first in-duty is going to be, because I think we all must realize that the fire service because of the equipment it has, the training it has, and its tradition, it is going to be the first on the scene and just about any manmade or natural disaster that you can think of.

And I can see the National Fire Academy again transferring programs and developing programs so that the fire service can be aware of the nature of the hazards involved.

Mr. **Brown**. Mr. Scoville?

Mr. **Scoville**. Mr. Chairman, I have a question not directly on the hazardous material.

But referring to Mr. Flinn's remarks on this earlier on the possibility of this Operation Dixieland, you said that you would support the concentration concept provided it did not mean detracting from existing programs, the realities of the budgetary process as you are well aware of we can authorize until we are blue in the face, but the appropriations committee actually has to dole out the money and given this year, it may be a difficult process to get any additional funds out of them.

Now, suppose the program on the order of, say, somewhere between $500,000 and $1 million a year for 2 or 3 years were proposed, do you then—that the bulk of those funds basically had to come out of the existing program allotment, do you think it is important enough to have this concentrated effort which can demonstrate visible results even if it had to take away from some of the existing programs on that order of magnitude, because that is probably the reality of what will happen, with actual moneys dealt out.

I would like to have you thought on—very easy to add money to it, very, but the question is whether you have to make a choice.

Mr. Flinn. Somebody has to bite the bullet, I guess.

Mr. Scoville. About that size of a program.

Mr. Flinn. I frankly don't know what the programmatic and budgetary activity relating to Operation Dixieland is described in Mr. Vickery's process.

I feel, however, that in trying to address all the various demands on the very limited budget they have to deal with, that they would certainly identify the largest number of resources to this kind of an activity if it had the most direct benefit to the greatest number.

If that means, if that translates out to say they are going to have to commit $500,000, $1 million over the multiyear period of time, or single year period of time, but the benefit will reach the greatest numbers of people than I would certainly say that is the kind of a program that philosophically we have supported in the past and would certainly support in the future.

Mr. Scoville. If I get you correctly, what you are saying is that if the Fire Administration could demonstrate this was essentially a more cost effective way to proceed, that you would support this type of activity even though it meant—obviously you are not going to tear up the whole program, but on that order of magnitude you might be willing to support that concept?

Mr. Flinn. And I would certainly think it would probably be addressed if that—using some series of numbers, for instance, if they would saturate the number of students with the National Fire Academy from those fire belt areas, those participant States, as an example, into a variety of public education programs, if they would develop pilot test activities in various cities in terms of arson detection or residential fire protection through the installation of low-cost sprinklers, or something like that, where it is going to have an effort in both testing and mitigating the problem, I would support that.

Mr. Schaitberger. Mr. Chairman, I would like to say the IAFF would take a somewhat different viewpoint.

Unless we were to see the program, and be assured of the actual need, we are here, if I may say reluctantly supporting the administration's request because we feel it is bare bones. We feel they need far more than they asked for, but we also acknowledge and live in the world of reality, and the present political environment that we are all dealing in.

As an example, there is less than $200,000 in the firefighter's safety and health section which our organization representing the numbers of firefighters we represent, believe should be one of the more important sections. If a new program like this were to cause some possible reduction in that kind of a program, or where to cause a reduction in the National Fire Academy at open university budget, we also believe is at bare bones, I think that unfortunately we would be forced to oppose such a new program. We would certainly support the program and the need for further funds, but not taking from Peter to pay Paul.

Mr. **Grimes**. I would like to reinforce that. We feel the same way. You have to be realistic about this. The total budget of the Fire Administration is pathetically small. You know, it is not a fraction of what it costs to run a fire department in a moderate sized city, so how you could do a concentrated capsulative program to see how it would work without putting massive funds in, I don't know. If you drew a little bit off it as Harold said, Peter to pay Paul, you are not going to do any more than is being done now.

I would suggest if you want to do it, it should work in several communities because communities have somewhat differing problems. But you have to put a lot of funds in to see measurable achievements within a short time, which is what the concept is, what will work.

For instance, one of the presupposed answers to the fire problem is far more inbuilt protection in building.

If you want to see how that is going to work in one community, you are going to have to put sprinklers or some fire protection in almost every building in the city, and that is a fantastic amount of money so in answer to your question, Mr. Scoville—"No," in answer to Mr. Brown's suggestion would this be a good idea, "Yes," if adequate funds were available. But the ongoing programs of the Fire Administration is on survival funds right now, just to keep the programs going and gradually building them up.

Mr. **Brown**. Well, knowing how persuasive Mr. Vickery is, he could probably persuade Mr. Macy to take some of that money of the civil defense program as he apparently did with regard to those ten regional representatives.

Gentlemen, we want to thank you very much for your testimony.

We are, I think, receiving a very good understanding of the Fire Administration and the problems and we certainly want to do everything we can to strenghten the operation. Thank you very much.

The subcommittee is adjourned.

[Whereupon, at 5 p.m., the subcommittee was recessed.]

[Questions and answers for the record follow:]

NFPA
"Moving Mankind Toward Safety From Fire"

NATIONAL
FIRE PROTECTION
ASSOCIATION
INTERNATIONAL

March 11, 1980

The Honorable George E. Brown, Jr.
Chairman
Subcommittee on Science, Research and
Technology
Suite 2321 Rayburn House Office Building
Washington, DC 20515

Dear Mr. Chairman:

Re: Authorization Hearings - U.S. Fire Administration

During our testimony before your Subcommittee we mentioned the increased cooperation between the U.S. Fire Administration and long established fire organizations such as the National Fire Protection Association.

One case in point that you should be aware of is the grant awarded to NFPA in support of the dissemination of information on the NFPA "Learn Not to Burn" Curriculum.

The curriculum was developed around twenty-five fire safety behaviors to be incorporated in the normal classroom activities for children in grades K through 8.

It is necessary for the education community as well as local administrators to be made aware of this educational program, its long term benefits and the compatibility of the curriculum contents with existing teaching materials and methods.

The USFA grant made it possible to hold 26 informational workshops to date with additional sessions to follow. The widespread dissemination of information made possible by this action is a significant demonstration of the cooperative and mutually supportive role that the Fire Administration is now playing. It is a fine example of the use of both public and private funds to the best effect in the public interest.

We would appreciate it if this example could be made part of the record of the Subcommittee hearings.

Sincerely,

Martin Grimes

Martin E. Grimes
Vice President

MEG:Kmd

SUBCOMMITTEE ON SCIENCE, TECHNOLOGY AND RESEARCH
February 26, 1980

QUESTION: Dr. Ziman - What responsibility and authority does USFA have on wildlands fire problem and how do we actually function?

ANSWER:

PL 93-498 establishing the USFA clearly includes wildlands fire protection in the broad, basic responsibilities and authorities assigned to USFA. Therefore, USFA is visualized as the focal point in the Federal Government for establishing policy and coordinating fire protection efforts. Wildlands are considered a significant part of the broad fire protection picture.

It is recognized that the U.S. Departments of Agriculture and Interior have responsibilities and have long provided leadership in the wildlands fire area. PL 95-313 consolidated the authorities of the Department of Agriculture (and its U.S. Forest Service) in the wildlands fire protection area. It should be noted that USFA is mentioned in this legislation as a partner.

The USFA is active in several major areas of wildlands fire. Examples are:

. Active liaison with the National Wildfire Coordinating Group (NWCG) which is the overall coordinating body for the wildlands fire protection groups of the U.S. Forest Service, Bureau of Land Management, National Park Service, Bureau of Indian Affairs, and Fish and Wildlife Service of the U.S. Departments of Agriculture and Interior and the National Association of State Foresters. This assures close communications and coordination between the USFA and all major wildlands fire protection groups.

. Development of guidelands for master planning for fire protection which are used by rural communities as well as urban departments. This publication is used by the NWCG organizations to promote planning activities.

. Development of a National Fire Incident Reporting System (NFIRS) which uses State-wide fire reporting of all types of fire incidents so that national estimates can be developed. The USFA maintains active membership on the National Fire Protection Association's Committee which has promulgated this uniform system of fire reporting in order to derive statistics and management information indicators that better define the problem and suggest corrective actions. USFA has worked to represent the wildlands fire community before they had representation on the Committee and were sponsors to get them on the Committee as active members. USFA is presently assisting NWCG in development of a suggested, single, Federal, wildlands fire reporting system. However, more and more States are becoming part of the NFIRS system and it is visualized that wildlands fire reporting will continue to be a part of this uniform system.

. USFA assisted in financing a study of rural fires with the U.S. Forest Service. It is believed that this detailed investigation will establish areas of priority concern and reveal areas where USFA programs can be of significant assistance, such as smoke detectors and sprinkler systems for rural properties.

. USFA sponsored the "Stonebridge Conference" this past year which brought volunteer fire service representatives together for the first time to develop their needs and have discussions with one another and USFA. This group has a heavy impact on the Wildlands area and we hope to keep this channel of communication open and develop it further.

. USFA is coordinating and integrating public education on fire to include wildlands. Several USFA projects are mutually supportive with the wildlands areas and close coordination is maintained between our two organizations to exploit this. The U.S. Forest Service chairs a National Fire Protection Committee in this area on which USFA has a representative.

Besides the need to continue and possibly expand the above areas of mutual interest and concern, there are several additional, important areas that need to be developed. Thises include:

. Address the urban/rural interface fire problems associated with fire prevention and suppression activities. More and more we have urban centers spilling over into rural areas. There is a need to develop commonality of terms, operating procedures, cooperative fire prevention efforts, and the like for such areas as Denver, CO.; Jacksonville, FL.; Houston, TX; and Los Angeles & San Diego, CA.

. Arson in the wildlands area is on the increase the same as in urban areas. More needs to be done to reverse this trend.

. Several State Forestry staff members are needed on USFA staff as IPA's to transfer the flavor of wildlands needs and ideas into our program.

It will take additional personnel and funding to maintain the existing services and move into the high priority needs of the future. There is at present one person and half a secretary to work the liaison with the NWCG agencies and to establish bridges of cooperation and coordination into additional or new areas as needs change.

SUBCOMMITTEE ON SCIENCE, TECHNOLOGY AND RESEARCH
February 26, 1980

QUESTION: Scoville - Describe operation Dixieland and estimate cost over 3 years?

ANSWER:

Operation Dixieland is a proposed program to reduce the tremendous losses from fires in the Southeast, especially in fire deaths. Nine Southeastern states - Arkansas, Louisiana, Mississippi, Alabama, Tennessee, Kentucky, North Carolina, South Carolina, Georgia — have the highest fire death rates in the U.S. (after Alaska), and the U.S. is tied with Canada for the highest in the world.

The concept is to work initially with 2 of these states over a three year period using programs and assistance from all parts of the U.S. Fire Administration. The cost would be approximately $500,000 per state per year.

The USFA would stimulate and assist people from the states themselves to a) increase public awareness and knowledge of the specifics of their local fire problem and what to do about it; b) train the fire service in the state on the ways to reduce their problem (e.ge. through public ed, inspections, fire investigations, better fire department management; c) motivate the state and its local governments to consider legislation for reducing the problem, and d) develop fire information systems to even better identify their problem, target solutions, and track results over time.

The program would attempt to gain the support and participation of the media in the state, the local fire departments, the national and state Congressmen, private volunteer organizations, (e.g. service clubs, churches), schools, insurance companies, smoke detector manufacturers, and other industry, leagues of cities and counties, fire chief and firefighter organizations, and other appropriate organizations.

Implementation would require a program coordinator and small staff (2-3) people to coordinate and help implement the project. These people would be selected from the region being helped if at all possible. The National Fire Academy would conduct courses in the area to train the fire service on ways to reduce the fire problem through public education, fire investigation, or whatever else seems most appropriate after consultation with the state. The National Fire Data Center would provide the details of the fire problem as best known to date for communication to the public and for targeting of the entire program. The Data Center also would help the state and local governments to improve their data system for identifying the problem further and evaluating progress. The Data Center would provide information on smoke detectors and other technology available in the short term and longer term for early detection and automatic suppression. The heart of the program, however, would involve the program of the Office of Planning and Education providing resources (materials) for conducting public education by Fire Departments and schools, development of media spots for public education; and, enrollment of private sector resources in the campaign.

An annual budget breakdown would be as follows:

| | |
|---|---|
| Project Coordination - | $150,000 |
| Media Spots | $100,000 |
| Technical Assistance and Resources to local departments in Public Ed (materials and Consultants) | $300,000 |
| Establishing Data Systems for state and local departments and producing special data analyses | $170,000 |
| Academy courses in states - | $200,000 |
| Grants to 2 states for coordinating efforts ($40,000 k each) | $ 80,000 |
| | 500,000 per state per year |

*SCOVILLE: USFA PRIORITIES FOR INCREASED FUNDING/AUTHORIZATION IN THE AREA OF ARSON.*

Arson Initiatives by Levels

| | | | | | | |
|---|---|---|---|---|---|---|
| Minimum Level | | | | Actual: | 3,340,000 | pos: 9 |
| Task | Staff | | C&G | Total | | |
| Arson Early Warning System (OPE) | 75 | (1.5) | 350 | 425 | | |
| Arson Task Force (OPE) | 50 | (1) | 300 | 350 | | |
| Arson Resource Center (OPE)[1] | 150 | (3) | 100 | 250 | | |
| Arson Public Education (OPE) | 50 | (1) | 300 | 350 | | |
| Arson Add-on Data System (NFDA) | 50 | (1) | 240 | 290 | | |
| Arson Program Management/Coor. (OPE) | 125 | (2.5) | 300 | 425 | | |
| Arson Investigation (NFA)[2] | 100 | (2) | 200 | 300 | | |
| Arson Detection (NFA)[3] | - | | - | - | | |
| Insurance Initiatives (OPE) | 100 | (2) | 200 | 300 | | |
| Housing Initiatives (OPE) | 50 | (1) | 150 | 200 | | |
| Arson Invest. Equipment (FRC) | 50 | (1) | 150 | 200 | | |
| Juvenile Counselling (OPE) | 50 | (1) | 200 | 250 | | |
| Total | 850 | (17) | 2,490 | 3,340 | | |
| Current Level | | | | Actual: | 4,125,000 | pos: 11 |
| Fire Invest. Handbook (FRC) | 50 | (1) | 60 | 110 | | |
| Arson Lab Initiatives (FRC) | 50 | (1) | 125 | 175 | | |
| Unknown Cause Study (NFDA) | 50 | (1) | 150 | 200 | | |
| Arson Program Evaluation (OPE) | 50 | (1) | 200 | 250 | | |
| Arson Prosecution (NFA) | 25 | (.5) | 25 | 50 | | |
| Total | 225 | (4.5) | 560 | 785 | | |
| 1st Level Enhancement | | | | Actual: | 4,920,000 | pos: 13 |
| Banking Initiatives (OPE) | 50 | (1) | 150 | 200 | | |
| Commercial Initiatives (OPE) | 50 | (1) | 170 | 220 | | |
| Arson Legislation (OPE) | 50 | (1) | 125 | 175 | | |
| Arson-for-Profit Profile (FRC) | 25 | (.5) | 50 | 75 | | |
| Arsonist Perceptions (FRC) | 50 | (1) | 75 | 125 | | |
| Total | 225 | (4.5) | 570 | 795 | | |
| 2nd Level Enhancement | | | | Actual: | 5,520,000 | pos: 14 |
| Equipment Users' Guides (NFDA) | 15 | (.3) | 150 | 165 | | |
| Industry Arson Data (NFDA) | 25 | (.5) | 120 | 145 | | |
| Treatment Analysis (OPE) | 50 | (1) | 240 | 290 | | |
| Total | 90 | (1.8) | 510 | 600 | | |

1. See #3 Synopsis (minimum level)
2. See #7 " " "
3. See #8 " " "

I. MINIMUM LEVEL SY 17 AMT: $3,340,000

1. Arson Early Warning System (SY 1.5 AMT: $425,000)

   Provides for the dissemination and installation of a program nearing completion. Models are being developed and pilot tested under current funding. In FY 81 municipalities will require technical assistance to implement the early warning packages to their management and data systems.

2. Arson Task Force (SY 1 AMT: $350,000)

   Provides for the development of models to meet the varying needs of county/state, big city/small city. Some dissemination of the models, but extended dissemination expected in FY 82. In given areas of the country, the task force approach has proven to be an effective management tool to provide interagency coordination in dealing with the arson problem. Good impact on fire loss.

3. Arson Resource Center (SY 3 AMT: $250,000)

   Provides for informational assistance to the arson constituency (arson investigators, task force personnel, lab technicians, prosecutors, etc). The Center will act as a clearing house on State and local arson programs, on research, education and training programs, and on legislative matters. A arson resource exchange bulletin will be published, providing a current awareness of programs, resources, problems, trends and legislation. High visability of USFA in a coordinating role. Note: In the "Other" category, money has been requested to develop and catalogue arson collection. Some possible overlap here, though the two efforts can be complementary.

4. Arson Public Education (SY 1 AMT: $350,000)

   Provides for the development of media packets on arson to be utilized by fire departments and other interested parties to educate the public about the arson problem. Model radio and TV public service announcements will be developed, posters, and a video tape/movie on the impact of arson on the public in terms of dollar and life loss. Expected that this initiative will give high visability to fire departments and their concern about the problem, build a base for maintaining and/or increasing arson investigation units. Education campaigns have proven to have a dampening effect on arsonist activities.

5. Arson Add-on Data System (SY 1  AMT: $290,000)

Provides for the development and testing of an add-on system to NFIRS to collect additional arson data. The add-on system would provide for the first time information which, when analyzed, would give good estimates of how the overall problem breaks down, juvenile vandalism vs. arson for profit vs. revenge fires, etc. Such information is needed for targeting solutions and measuring progress at both the national and at the local levels.

6. Arson Program Management and Coordination (SY 2.5  AMT $425,000)

Provides for responsible management and coordination of USFA initiatives, particularly as they relate to the arson activities of other Federal agencies. This initiative will be particularly important if the Glenn Bill is enacted. The bill creates a Federal arson task force with no funding. If the USFA Administrator leads this task force, this initiative will provide a base for active and meaningful coordination.

7. Arson Investigation (SY 2  AMT $300,000)

In FY 81, the Academy will be offering its two-week arson investigation course at its home site, as well as in the field on a limited cluster basis. This initiative provides for the expansion of the field offerings, namely that the course will be offered twenty times. Training is a need constantly stated by the USFA's fire constituency; the target population of arson investigators need to be trained at a faster rate.

8. Arson Detection (SY 0 AMT: 0)

In FY 79, the Academy will hand off to State Fire Marshals and training officers in cities of over 200,000 population the detection course at no cost. The detection course is for the on-line firefighter and officer and trains them to analyze a fire site to determine if a fire investigator should be called. The task group felt that the dissemination of the course was very important and that if for any reason it did not receive wide distribution by FY 81, it should. No amounts are stated, in that it is assumed that distribution costs for Academy packages for found elsewhere in the budget. Like the previous initiative, this initiative can be removed; it is here simply to draw attention to the need.

9. Insurance Initiatives (SY 2 AMT: $300,000)

Provides for the coordination with the Federal Insurance Administration, National Association of Insurance Commissioners and the Insurance All-Industry Committee for Arson Control to monitor and evaluate the implementation and impact of the Recommendations for removing insurance incentives to arson found in the USFA Report to Congress. Leveraging is a strong possibility here, particularly related to evaluation forums and model building.

10. Housing Initiatives (SY 1 AMT. $200,000)

Provides for coordination with the Department of Housing and Urban Development, The Neighborhood Reinvestment Corporation and the Economic Development Administration to monitor and evaluate the implementation and impact of the Recommendations related to federal, state and local housing policies as they impact the arson problem. Strong possibility of leveraging with HUD and strengthening USFA role of arson coordination within the federal government.

11. Arson Investigation Equipment (SY 1 AMT. $200,000)

Provides for the assessment of arson investigation equipment in terms of performance and ease of operation (readability of gauges, portability, durability, etc.). Equipment specifications will be developed, which will provide a guide to local decision-makers in making equipment purchases. In that many of the tools used today by the arson investigator were not designed to detect arson evidence, this initiative should lead to an improvement of equipment for the field investigator.

12. Juvenile Counselling (SY 1 AMT. $250,000)

Provides for dissemination and technical assistance to communities for the installation of a program nearing completion. Models for counselling juvenile firesetters have been developed and will soon be pilot tested. Since juvenile firesetting is a major factor in the arson picture, it is expected that this initiative could have significant impact on loss due to arson.

II. CURRENT LEVEL SY 21.5 AMT: $4,125,000

1. Fire Investigator's Handbook (SY 1 AMT: $110,000)

Provides for the revision of the handbook being developed in FY 79. The FY 79 handbook will be a technical reference designed specifically to meet the needs of the fire investigator. Scientific, legal and investigative information will be included in the text. In the FY 81 revision, information gained from new research and technology, as well as user comments will be inserted where appropriate. The handbook is a tool that has been lacking in the past (in terms of having essential information in one place) and it is expected that the revision of the text will make the investigator even more effective in his work.

2. Arson Lab Initiatives (SY 1 AMT: $175,000)

Provides for the determination of appropriate workloads in laboratories, the development of guidelines and specification for minimum basic equipment for labs, and the development of a booklet describing the characteristics of a model arson lab. The turn-around time for arson evidence has been particularly criticized in the field and this intiative will address this problem.

3. Unknown Cause Study (SY 1 AMT: $200,000)

   Provides for a study of unknown cause fires, to be conducted in ten NFIRS states. Based on the study a statistical methodology will be developed that will allow the National Data Center to estimate with reasonable confidence how "unknown cause" should be distributed among the cause categories. This will improve estimates of the arson problem and the ranking of major causes. It will also help state and local governments to make their own estimates and reduce erroneously labeled fires.

4. Arson Program Evaluation (SY 1 AMT: $250,000)

   Provides for the application of a cost/benefit tool developed for the USFA Report to Congress. This tool will be particularly useful for the federal arson task force in analyzing the potential effectiveness of inter-agency and singular agency arson initiatives.

5. Arson Prosecution (SY .5 AMT: $50,000)

   Provides for the updating of the arson prosecution course to be utilized by the National College of District Attorneys in FY 79. This course was developed with imput for the National Fire Academy. The essential reason for this recommendation is to keep involved with the prosecutors. By maintaining this involvement we can possibly leverage funds from LEAA, or if not that, at least assume some credit for the training of prosecutors to deal effectively with the arson case in court.

III. FIRST ENHANCEMENT LEVEL SY 26 AMT: $4.920,000

1. Banking Initiatives (SY 1 AMT: $200,000)

   Provides for coordination with Federal banking regulators and banking associations to monitor and evaluate the implementation and impact of Recommendations in the USFA Report to Congress on reducing incentives to arson found in banking policies and practices. Leveraging possibilities nor impact is expected to be as high as insurance/housing initiatives.

2. Commerical Initiatives (SY 1 AMT: $220,000)

   Similar to the previous initiative, except the emphasis is on removing commerical and business incentives to arson.

3. Arson Legislation (SY 1 AMT: $175,000)

   Provides for an analysis of state laws that may impact the arson problem. Such an analysis will identify those laws that may act as incentives to the arsonist, and those laws which may act to deter the arsonist. After such an analysis, it would be expected in the next fiscal year, that some state represent atives responsible for writing laws would be brought together to write model legislation.

4. Arsonist-for-profit Profile (SY .5 AMT: $75,000)

   Provides for a study to identify the psychological, sociological and economic characteristics of the fraud arsonist. With a better understanding of the motives and makeup of the arsonist-for-profit, authorities may be better equipped to develop more effective prevention and treatment programs specific to this type of firesetter.

5. Arsonist Perceptions (SY 1 AMT: $125,000)

   Provides for a study to determine and contrast perceptions of arsonists and the perceptions of presumed non-arsonists with similar backgrounds. Emphasis will be placed on the perceptions of risks and gains by both groups. The results may prove helpful in evaluating the effectiveness of on-going and proposed action programs.

IV. SECOND ENHANCEMENT LEVEL SY 27.8 AMT: $5,520,000

1. Equipment Users' Guides (SY .3 AMT: $165,000)

   Provides for the development, testing, and dissemination of guides and instructional materials associated with recommended equipment.

2. Industry Arson Data (SY .5 AMT: $145,000)

   Provides for the collection from selected industries of data on their arson fires and fires of suspicious and unknown origin. This study is required because a large percentage of fires in industry are not attended by public fire departments and therefore the National Data Center is not currently receiving information on such fires in NFIRS. The outcome would be a better estimate of the overall arson problem.

3. Treatment Analysis (SY 1 AMT: $290,000)

Provides for a study on the methods of treatment of firesetters. There is very little quantitative information on the effectiveness of existing and proposed clinical arson treatment programs. This study would attempt to establish basic characteristics attributable to successful adult and juvenile treatment efforts.

# EARTHQUAKE AND FIRE ACT AUTHORIZATION

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**WEDNESDAY, FEBRUARY 27, 1980**

House of Representatives,
Committee on Science and Technology,
Subcommittee on Science, Research and Technology,
*Washington, D.C.*

The subcommittee met, pursuant to notice, at 8:07 a.m., in room 2325, Rayburn House Office Building, Hon. George E. Brown, Jr., presiding.

Mr. Brown. The subcommittee will come to order.

This morning we continue with a series of hearings dealing with the earthquake hazard mitigation program, which is under the jurisdiction of this subcommittee. We are very privileged to have a distinguished delegation from the U.S. Geological Survey, headed by the Director of the Survey, Dr. Menard, and his two associates, Dr. Wesson and Dr. Filson.

We welcome you, Dr. Menard, as a distinguished Californian. You may proceed with your statement, the full text of which will be included in the record at this point.

[The biographical sketch of Dr. Menard follows:]

## Biographical Sketch of

## Dr. Henry William Menard

## Director, U.S. Geological Survey

H. William Menard received his B.S. in Geology (1942) and M.S. (1947) from the California Institute of Technology, and his Ph.D. in Geology from Harvard University in 1949.

From 1949 to 1955, he was a marine geologist at the Navy Electronics Laboratory, San Diego, California. He joined the Scripps Institution of Oceanography, San Diego, as a Professor of Geology, a position held until be became Director, U.S. Geological Survey, in April 1978. From 1949 to 1977, he participated in 20 deep sea oceanographic expeditions in many areas of the Pacific and across the Atlantic. During 1953-56, he was involved in underwater mapping off the coast of California; he made more than 1,000 aqua-lung dives for geological purposes. His scientific studies resulted in 100 scientific papers, including four books.

In 1965-66, he was a Technical Advisor in the Office of Science and Technology, Executive Office of the President, responsible for marine and Earth sciences.

He has served on many committees of the National Academy of Sciences concerned with natural resources, and the development of offshore oil.

Honors include: election to the National Academy of Sciences, American Academy of Arts and Sciences, and the California Academy of Sciences; a Guggenheim Fellowship; an Overseas Fellowship from Churchill College, Cambridge University; the Shepard Medal of the Society of Economic Paleontologists and Mineralogists; and the Distinguished Alumnus Medal of the California Institute of Technology.

Professional affiliations include: Geological Society of America; American Geophysical Union; and American Association of Petroleum Geologists. He is a Registered Geologist, State of California.

## STATEMENT OF DR. H. W. MENARD, DIRECTOR, U.S. GEOLOGICAL SURVEY, DEPARTMENT OF INTERIOR

Dr. MENARD. Thank you, Mr. Chairman. It is a pleasure to be talking to a distinguished Californian and your associates here.

We have escaped a good deal of rain from being in this vicinity, but I am sure you have been as concerned as I have about what has been going on in California these days.

Mr. BROWN. Yes, sir, I am very much concerned.

Dr. MENARD. We have, interestingly enough, last week discussed the flood. The matter that concerned us most was that there might be an earthquake in the vicinity that would trigger landslides in the heavily saturated ground, as the principal earthquake related problem is not the runoff of water, but that the water is not running off. It is going into the ground and the ground is getting more and more saturated. There would be some pyramiding effect of that sort that would probably generate a disaster—a major destructive disaster—even without a large earthquake of the sort that we nonetheless anticipate by itself.

I have a prepared statement but, as you kindly said, it is read into the record at this point. I will dismiss it.

I would like to mention the fact that, as an indication of the survey, and its in high regard for Dr. Wesson and, also, for his particular expertise in earthquakes that he is leaving his position as head of the Office of Earthquake Studies and is becoming an Assistant Director of the Survey.

Mr. BROWN. That is, I presume, a promotion? [Laughter.]

Dr. MENARD. I would like to look upon it as that. I did have to twist his arm a bit and say so.

Dr. Filson will be acting as head of the Office of Earthquake Studies from here on.

It is commonly realized that earthquakes occur all over this country; and, when you can pyramid rainfall and earthquakes together, perhaps, the effects of earthquakes are even more devastating and can be more widespread than appreciated.

Certainly the program we carry out all over the country is progressing due to our increasing understanding of the problem. We essentially understand why you get earthquakes around the Pacific margin, and we understand or we have ways of predicting where we are going to get new earthquakes and so on. We have nothing like that in the Eastern United States and in Central United States. We do not even have a crude model, unless my colleagues here have come up with it in the last week. We do not have a theory to explain why we are getting earthquakes in such places.

We are responding to a nationally sensed need for further studies of earthquakes, but I think the initial program is coming to an end and, meanwhile, the funding for the program has dropped steadily below what I think is the optimum. The need certainly continues. The program, I think, has justified itself. It has been successful. We need to continue it, and I think it will turn out that we are going to need more funds to support it.

With those remarks, I would like to make ourselves available to your questions.

[The prepared statement of Dr. Menard follows:]

TESTIMONY OF H. W. MENARD, DIRECTOR, U.S. GEOLOGICAL SURVEY,
DEPARTMENT OF THE INTERIOR, BEFORE THE HOUSE SUBCOMMITTEE ON SCIENCE,
RESEARCH AND TECHNOLOGY, COMMITTEE ON SCIENCE AND TECHNOLOGY
FEBRUARY 27, 1980

Mr. Chairman, I thank the Committee for this opportunity to review for you progress toward the reduction of earthquake hazards since the passage of the Earthquake Hazards Reduction Act of 1977. The Geological Survey has been at the forefront of this work. We are very proud of the program we have developed in response to this Act and of the results we have achieved to date. In previous testimony before this Committee witnesses from the Geological Survey have described the nature of the hazards posed by earthquakes and their distribution throughout the country. I will not repeat that previous testimony except to reemphasize that the earthquake threat is a problem facing us, not only in California and Alaska, but in many regions throughout the country, particularly the Intermountain States, the Pacific Northwest, the central Mississippi Valley, the Southeast, the Northeast, and Hawaii. We are currently conducting at least some work in each of these areas. Within the last several months, the potential hazards from earthquakes and the vulnerability of structures to these hazards have been tested by the occurrence of moderate earthquakes in the Imperial Valley and Livermore Valley regions of California. Both these earthquakes occurred in areas of low population density, the Livermore earthquake on the very margin of the suburbs of the San Francisco metropolitan area, and the Imperial Valley earthquake in a largely agricultural area. While the observations from these earthquakes are still being evaluated by scientists and engineers, they already underline the lessons learned from the 1971 San Fernando earthquake. Namely, very large earthquakes, or even moderate earthquakes, located within one of our metropolitan areas at risk, will have very serious impacts.

In this morning's testimony, I would like to describe briefly the nature and content of our program, focused heavily in research; to indicate the research results we have obtained to date; to review our progress toward the milestones in our areas of responsibility as indicated in the National Earthquake Hazards Reduction Program; to discuss our views about the implementation and information dissemination issues involved with this program which have concerned this Committee; and finally to describe for you the Administration's proposal for legislation to continue and to further implement the program established by the Earthquake Hazards Reduction Act of 1977.

The Earthquake Hazards Reduction Program within the Geological Survey is cast in five elements or sub-programs. These are: earthquake hazards assessment, earthquake prediction, earthquake data and information, induced seismicity, and earthquake hazards warning. I shall comment briefly on each of these program elements.

1. The earthquake hazards assessment studies form the base of information required to mitigate earthquake losses through understanding of where earthquakes will occur, how often they will occur, and what their effects will be. Assessments of the nature, extent, and severity of earthquake hazards and of the potential resulting losses are needed at various levels of government, by private industry, and by the public for decisions about construction practices, use of land, disaster preparedness, and recovery, and response to earthquake predictions. Earthquake hazards assessments are required at various scales and for various geographical areas to satisfy an array of different needs. Uniform assessments of earthquake hazards for the entire Nation are needed, for example, as a basis for developing model building codes, for evaluating the earthquake hazard exposure of domestic and industrial facilities, and for incorporating hazard mitigation

measures in Federal activities. More detailed assessments at larger map scales are needed in areas of high-seismic risk to guide Federal, State, and local government policies relating to land use, construction practices, and disaster preparedness and recovery.

Thus far, earthquake hazards studies have made progress in developing methods and techniques for the specification of earthquake risk and in understanding the physical processes and conditions that influence the occurrence and severity of particular earthquake hazards in given regions. This progress supports current efforts to map and evaluate hazards nationwide and in metropolitan regions exposed to damaging earthquakes. However, much work remains to be done to increase our understanding of the geologic sources of seismicity in the eastern United States, our ability to predict the nature of damaging ground shaking, and our knowledge of the conditions and character of earthquake-induced ground failure and landsliding.

2. The goal of the earthquake prediction element of our earthquake program is to predict the time and place of moderate to large earthquakes and to provide estimates of the uncertainties of these predictions. In order to do this we must also develop an understanding of the physics of the phenomena observed in the predictive process. To reach the goal of reliable earthquake prediction, efforts are being made on a broad scientific front. Given the current level of understanding of the prediction problem, no one discipline or technique can be identified as the most direct path to solution of the problem.

Dense networks of geophysical observations and instruments have been established in California and other seismically active regions of the United States. Data from these networks are scrutinized in intense observational studies that search for and evaluate precursory phenomena. Although interesting and exciting observations have been made by these networks, we have yet to identify a reliable, widely accepted predictive technique. We are making efforts to share experience and expertise through international cooperation with foreign activities engaged in earthquake prediction research. This pooling of scientific knowledge and field investigations, which we can promote and even influence through modest allotments of our resources, allows us to increase the number of prediction case histories and the number of seismic regions available to us for study. Finally, extensive laboratory studies are being conducted to observe, under controlled conditions, the nature of the deformation and other phenomena in rocks just prior to failure. These experiments have given us significant insight into the processes of geologic faulting and the conditions under which it occurs.

3. The earthquake data and information element of our program includes the support of worldwide networks of seismometers of standard design and the routine analyses of the data from these networks to produce information on earthquake epicenters, magnitudes, and other seismological parameters. By providing supplies and maintenance, the Geological Survey supports the operation of some 120 seismographic stations throughout the world. Data from these stations are routinely transmitted to the United States where they are copied and returned to the cooperating stations. These data are used in basic research on earthquake source mechanisms, earth structure, plate tectonics, and seismic energy propagation. Data from these stations and others are analyzed at the National Earthquake Information Service in Golden, Colorado, from which bulletins and exhaustive lists of worldwide seismic activity are issued. All of these data are forwarded to NOAA's Environmental Data and Information Service for distribution to scientists and the public in general.

4. In addition to earthquakes due to natural causes, we are also

studying induced seismicity, that is, seismicity caused by the activities of man. Earthquakes can be triggered by a variety of man's activities including reservoir impoundment, fluid injection, fluid withdrawal, quarrying, and the detonation of large underground explosions. Our studies have been concerned primarily with reservoir-induced seismicity and the related problem of fluid injection into or withdrawal from geologic formations. We seek to acquire a better understanding of the mechanisms through which earthquakes are induced and to devise techniques for predicting the seismic response of a particular site to reservoir impoundment or fluid injection or withdrawal. Most importantly, we need to determine the conditions under which a damaging earthquake may be induced and the prevalence of these conditions in the Earth's crust.

5. The last, and perhaps most important, element of our program involves support of activities in the evaluation and dissemination of information on earthquake hazard warnings. This effort supports the National Earthquake Prediction Evaluation Council called for under the provisions of the Earthquake Hazards Reduction Act and the President's Implementation Plan issued in June 1978. This program element will continue to expand to support research on the impact of earthquake hazard warnings on affected communities and the operational aspects of documenting, evaluating, and disseminating earthquake hazard information.

I would now like to take this opportunity to review for you some of the progress we have made in achieving the goals of our program. I will start by outlining our progress in earthquake hazards assessment. The New Madrid seismic zone, so named for the town of New Madrid, Missouri, contains the epicenters of perhaps the most violent series of earthquakes in United States history. These events, which occurred in 1811 and 1812, caused considerable damage to the few existing structures in the area and caused much deformation of the Earth's crust along the Mississippi River in the States of Arkansas, Missouri, Kentucky, and Tennessee. Seismicity has continued to the present day in the area. Although the potential for damaging earthquakes in the area has long been recognized, until recently it had been difficult to estimate the hazard associated with the seismicity, in part because the source of the seismicity was poorly defined. The great thicknesses of young sediments covering the zone effectively obscured any major faults. We have recently applied techniques used by the petroleum industry to this problem and have discovered a major fault zone in northeastern Arkansas, across which buried basement rocks may be offset by a thousand feet or more. Improved locations for small earthquakes in the area show they form a linear band coinciding with the newly determined fault zone. Other geophysical studies have shown that the fault zone lies near the center of a much longer rift zone. These observations, and our continuing work, will be of value for estimating hazards in the area.

When an active fault zone is discovered, one question that is obviously important is the length of time between major earthquakes on the fault. Estimates of these return periods can be made by several techniques, including analyses of historical records, examination of disturbed strata in excavations, studies of fault scarps, and theoretical consideration of geologic forces. These techniques have been applied in several areas of the United States with good results. I will briefly describe some examples of these techniques and their application.

The shaking that occurs during an earthquake sometimes causes considerable deformation of loosely compacted sediment. If such deformation occurs in sediments recently deposited in lakes or streams, and if these contorted sediments are then covered by normally stratified deposits, a record of the shaking is preserved. Just such disturbances were found near the San Andreas fault by geologists who dug trenches and examined the sediments exposed in the trench wall. The investigated locality was on Pallett Creek, near Palmdale, some 50 miles northeast of Los Angeles. By determining the age of several disturbed layers, large earthquakes on this particular stretch of fault were found to have occurred every 160 years, on the average. Of course, earthquakes occurring on nearby faults will increase the frequency of earthquakes experienced.

Similar studies in trenches have been carried out in the central United States, and have shown that at least three large events, including the 1811-12 New Madrid earthquakes, occurred near Reelfoot Lake, Tennessee, in the last 2,000 years. The mean recurrence interval is thus about 670 years. In addition, a study of the observed frequency of smaller earthquakes has been used to estimate an upper limit of 600 years for the return period of larger events in the same general region.

Studies of the extent of erosion of exposed faulting surfaces are being used to estimate the movement along these surfaces. This technique has shown that a zone extending across Utah from Nevada to the Wasatch Front has been active in Holocene time (the last 10,000 years). Furthermore, fault surfaces or scarps younger than 15,000 years were found across the entire zone. This type of data was used in a study of potential earthquake losses in the Salt Lake City area. The purpose of this study was to provide essential data relating to earthquake effects on local medical resources, estimated casualties and homeless, and immediate and vital public needs under various conditions of earthquake occurrence. The intent was to give administrators of emergency services information needed to plan responses to earthquake disaster.

The determination of recurrence intervals for damaging earthquakes is of considerable value to the Earthquake Hazards Reduction Program because it allows one to quantify the risk associated with a given fault. In the absence of such data, estimates of the interval between large earthquakes are indirect and apt to be uncertain by hundreds of years or more. When reliable data are obtained that establish firmer limits upon return intervals for earthquakes on a given fault, correspondingly more realistic estimates may be made of the hazard presented by the fault to life and property.

A final important result of our earthquake hazard assessment work was achieved this fall when, during the Imperial Valley earthquake, a network of instruments designed to record strong ground motion performed beyond our expectations. Strong ground motion data are used by engineers in the design of earthquake-resistant structures. The strong motion data recorded from the Imperial Valley event form the most complete set of this type of data yet recorded, including the first complete set of known records of shaking in a modern building that suffered structural failure in an earthquake. These data will do much to advance our knowledge of the nature of strong shaking from earthquakes and of how buildings fail in response to that shaking.

Our activities directed toward achieving reliable and accurate earthquake predictions have included intensive geophysical and geodetic measurements along actual faults in California and elsewhere, laboratory studies of rock failure processes, and direct measurements of the state of stress in the Earth's crust. During 1979, two damaging earthquakes occurred in California within dense networks of geophysical instrumentation. Although no obvious precursory activities were observed before these events, the data are still being reduced and analyzed in efforts to identify such phenomena.

In addition to recording geophysical data directly relatable to earthquakes, several important observations have been made in southern California during the last few years that are not yet fully understood.

A huge land uplift or "bulge" in southern California, astride a section of the San Andreas fault, has continued to deflate or subside. Geodetic surveys revealed that about 32,000 square miles of southern California was uplifted as much as 18 inches between 1961 and 1974. Since 1974, instead of uplift there has been a rapid decline in elevation with the entire region from Los Angeles to the Mojave tilting to the north. With minor fluctuations, the subsidence of the bulge has continued through the early summer of 1979, with 1978 uplift levels being about one-third of those observed in 1974.

The last year has also seen a dramatic change in the horizontal strain field in southern California. Regularly resurveyed geodetic networks have shown consistently a general north-south compression from 1974 until early in 1978. The most recent surveys indicate that the southern California region is now undergoing an east-west extension with little north-south compression. Observations from radio astronomy have confirmed these surprising geodetic data. The San Andreas fault cuts across this region in a northwest-southeast direction. As long as the north-south compression was observed our interpretation was that the sides of the fault were being pressed together and perhaps less likely to slip. Now that we are observing east-west extension, the same logic implies that slip on the fault might more easily occur. No physical model has yet been proposed that can account for the subsidence of the southern California uplift and the change in horizontal strain patterns observed in the same region.

Additional measurements in southern California have shown that the minute volume of natural, radioactive gases from certain wells in the Los Angeles region increased far above normal in mid-1979. Similar increases have been observed prior to earthquakes in the USSR, though at considerable distances. Water levels in some wells in southern California have shown changes that are not easily explained on the basis of rainfall or water withdrawal. These hydrological observations may be a consequence of the recently observed patterns in crustal strain.

The use of these observations to predict earthquakes in southern California at this time is not warranted on two accounts. The first is that we do not fully understand the physics of the earthquake process and the changes that take place in rocks prior to fault breakage. Secondly, the length of time over which our observations have been carried out is so short that we cannot tell if observed changes in our geophysical measurements are truly anomalous. It is basically the coincidence in time of observed anomalies in southern California that has caused concern in the scientific community, not their relation to a well founded and well accepted scientific theory of earthquake prediction or a long history of similar anomalies being followed by earthquakes.

As I have indicated earlier, detection and interpretation of short- or intermediate-term precursors remains a challenging task. By contrast, certain long-term predictions seem to be rather successful. The basic premise of the theory is that the margins of tectonic plates move at constant rates when averaged over long periods of time and that most of this movement occurs during discreet events, i.e. earthquakes. Thus, if along a plate boundary, a certain region has not had seismic activity of the size and within the time period of neighboring regions, a seismic gap is said to exist. This gap is said to be the most likely place for the next earthquake along that region of the plate boundary. The seismic gap theory, when applied to the active margins of the Pacific Ocean basin, has predicted the sites of a number of large earthquakes. The method identifies areas where earthquakes have not occurred in some time, and evaluates the potential for occurrence in terms of historic activity and plate tectonic theory. The method has little resolution in predicting the expected time of an earthquake, but serves to focus attention on areas that can then be better and more closely monitored for shorter-term precursors. A case in point is the Yakataga Seismic Gap in Alaska, which was identified as the probable site of an earthquake last year. The response of the Geological Survey to this situation is a subject I will address in a moment.

One final area of significant progress in earthquake prediction has been in the application of techniques to mesure directly the state of stress in the Earth's crust. These measurements have been made, among other places, in a profile of drilled bore holes across the San Andreas fault. The results of this work indicate that the crustal stresses decrease near the fault, a finding consistent with estimates made from seismological techniques. This observation gives an indication of the size of stress-related precursory phenomena that might be observed before an earthquake.

Because the prediction program must have data by which to judge theories and prediction methods, cooperative programs have been established with foreign governments. This gives our scientists access to more earthquake data and to more experience observing large earthquakes than would be the case in the United States. The Geological Survey has had cooperative programs with the Soviet Union and Japanese agencies. About a month ago I traveled to Beijing with the President's Science Advisor, Frank Press, to sign a protocol with representatives of the State Seismological Bureau of the People's Republic of China for cooperative studies in earthquake research. Instrumental observation of earthquakes in foreign countries is carried out by personnel of the Geological Survey and by contract with university scientists. We expect these programs to advance our theroetical and observational base considerably.

The most significant results in our efforts to study induced seismicity have come studies of the Monticello Reservoir in South Carolina. Small earthquakes have been observed in the vicinity of this reservoir since impoundment began in December 1977. By April 1978, over 3,000 small earthquakes had been recorded, most of these occurring during and just after the period when the lake level was rising to a stable level. To test the hypothesis linking the occurrence of these earthquakes to interactions of pre-existing tectonic stress and change in water pressure caused by the impoundment of the reservoir, two wells, each to a depth of about one kilometer, have been drilled near the reservoir and stress measurements have been made in them using techniques employed along the San Andreas. Although the wells were drilled at geologically similar sites, the two are markedly different in the magnitudes of the stresses measured, the distribution and orientation of natural fractures, and sub-surface water pressure. These results demonstrate that distinct earthquake source zones exist beneath the reservoir, as suggested by the geographical seismicity pattern, and that the earthquakes are probably not occurring in response to a high regional stress field. The implication is that the earthquakes are a direct result of the stresses generated by the reservoir loading, and that the potential for triggering a large earthquake due to a broad pattern of large regional stresses is low. If the sizes of potential local earthquake source zones could be found through a detailed measurement program, a more reliable estimate of the maximum potential earthquakes could be made.

The most important recent event in our Earthquake Data and Information program element has been the assumption of the operating responsibility for the Global Digital Seismic Network in FY 1980. This network consists of 16 modern, digitally recording seismographic stations installed at worldwide sites with funding from the Defense Advanced Research Projects Agency. The assumption of the responsibility for this network required some re-programming of funds from earthquake prediction studies.

I have spoken earlier about hazard warnings, and would like to illustrate the process with some examples. I mentioned earlier that a long-term prediction had been issued for an area in Alaska. This area had been identified by a group of university scientists some years ago as one in which a large earthquake could be expected to occur. Early in 1979, a strong earthquake did occur there. This event was too small to be the predicted event, but because of its location and size it focused attention even more upon the region. An analysis of the existing data convinced the scientists at Columbia University and the Geological Survey that the region was indeed the likely site of an impending earthquake, and a scientific paper was prepared to publically state this conclusion. Because of the size of the predicted event and its possible impact on to settled areas in Alaska, an evaluation procedure was initiated to examine the basis for the prediction so that I could take any necessary steps required to inform the appropriate Government officials. A group of university and Survey scientists met and discussed the evidence, and in general the likelihood of an earthquake was found to be high sometime in the next few decades. This information was communicated to officials of the State of Alaska and to the Canadian government.

I would now like to review our progress toward the specific implementation responsiblities outlined in the President's National Earthquake Hazards Reduction Program. Briefly, we were given five tasks:

- conduct research on the nature of earthquakes, earthquake prediction, earthquake hazards evaluation, and induced seismicity.
- evaluate earthquake predictions with the advice of a National Earthquake Prediction Evaluation Council
- prepare national seismic risk maps
- evaluate earthquake hazards on a regional basis
- provide data and information on earthquake occurrences and hazards.

Our research programs and accomplishments have been described in detail above and I shall not dwell on them further. The National Earthquake Prediction Evaluation Council has been established and has had its initial meeting. This meeting was used to draft operating procedures for the Council and not to evaluate any specific prediction. The Council is chaired by Dr. Clarence Allen of the California Institute of Technology and is made up of government and non-government scientists. Its purpose is to advise me, or whoever the Director of the Geological Survey happens to be, on the significance and credibility of earthquake predictions, so that I can fulfill my obligations with respect to geologic hazards warnings. The Council will not initiate or make any predictions itself, but restrict its activities to evaluating the predictions of others.

Our efforts to prepare national seismic risk maps are well underway and draft versions of these maps should be completed by the winter of 1980. These maps may be used to estimate the probability of a certain level of ground shaking not being exceeded within a given period of time. The probabilistic method of constructing ground-shaking maps has advantages that deterministic methods do not have, in that the latter cannot reflect the statistical distribution of physical parameters that affect ground motion.

We have made substantial progress in gathering the data necessary to develop a series of maps, on a regional scale (1:250,000), of ground shaking and possibly ground failure. These maps will be useful and more detailed extensions of the national-scale maps. It is anticipated that they will include information such as age dating of faults in California, Utah, and Nevada; results of studies of the causes of earthquakes in the eastern United States; and physical correlation between earthquake occurrence, regional tectonics, and deep geologic features, especially in the eastern United States. These maps will be developed first for those urban areas of the United States where sufficient advances in earthquake source zones have occurred to warrant refining national scale maps. Regions for which maps or reports are being prepared include the San Francisco Bay region, the Wasatch Front area, southern California, the Mississippi Embayment area, and the Charleston, South Carolina, area.

The basic mission of the Geological Survey in the National Earthquake Hazards Reduction Program is to conduct research and to gather basic earth science information, but we recognize that our responsibility does not end with research. This is emphasized in the plan for the National Earthquake Hazards Reduction Program. To contribute to the reduction of earthquake hazards the information developed by the Geological Survey must become an important factor in decisions about building codes, land use, planning for emergency services, and so on. These decisions are made by individuals and institutions in a wide spectrum of private and governmental settings. The reduction of earthquake hazards in the United States cannot be accomplished by mandate. It can only be accomplished through increased awareness and improved provisions in a wide variety of private, local State and Federal practices and regulations.

The Geological Survey cannot and should not implement policies to reduce earthquake hazards, but we must provide the best possible scientific information in a manner which is as useful as possible to the decision maker. This is not an easy process and we do not have all the answers, but I would like to tell you what we have done and are doing to develop lines of communication and facilitate public education. We are, of course, proud of the quantity and quality of the scientific publications emanating from this work. These publications must provide the basis for the a public information program. But we are working very hard to improve our procedures for transmitting and disseminating information about earthquake hazards to non-specialists. We are publishing increasing numbers of reports and maps aimed at engineers, land-use planners, and other non-earth scientists. In addition, we have had two workshops involving individuals from widely varying backgrounds and interests on the general topic of earthquake hazard information, one in January of this year focused specifically on the question of earthquake prediction. These conferences have led to a number of recommendations which we are working to implement.

With regard to the reauthorization of the Earthquake Hazards Reduction Act of 1977, and matters related to our activities under this Act, the Secretary submitted a proposal to Speaker O'Neill and the President of the Senate on May 25, 1979, to extend authorizations for appropriations, due to expire September 30, 1980, for sums that may be necessary beyond that date to carry out the purposes of the original Act. The accomplishments described above represent only a beginning, and authority for extension of authorizations is necessary to allow the continuation of these efforts.

In conclusion, I would like to thank you, Mr. Chairman, for this opportunity to present our program, accomplishments, and plans for reducing earthquake hazards in the United States. We feel we have developed a successful and dynamic program and we look forward to moving ahead vigorously toward our ultimate goal of protecting lives and property from the earthquake threat.

Mr. **Brown**. Would Dr. Wesson or Dr. Filson like to add any remarks of their own?

Dr. **Wesson**. Not at this time, Mr. Chairman.

Dr. **Filson**. No, Mr. Chairman.

Mr. **Brown**. Dr. Menard, we appreciate your frankness in discussing the program.

Our basemark approach to this is that the original program, which was based upon the recommendations of technical study and report—the recommendation of that report, the Newmark report—are still the best guide that we have, until we get something better.

We are substantially running below the level of effort recommended there.

Would you concur that still represents the reasonable goal described for it, in order to maintain a vigorous program in this area or, possibly that it is either too high or too low? I don't know whatever views you like to express, but we would appreciate it.

Dr. **Menard**. What has happened basically is that the initial funding was above the median recommendation of the Newmark committee.

Mr. **Brown**. Very slightly.

Dr. **Menard**. Subsequently, taking no account of inflation, it has dropped down to the bottom of the recommendations. It is still more or less within the range of recommendations; but, meanwhile inflation alone is degrading the research effort that we can put into this program by a very substantial amount. I have not calculated it, but I wouldn't be surprised that we are probably down about two-thirds of the minimum recommendation of the Newmark report.

Dr. **Wesson**. Even without inflation, we are significantly below for fiscal year 1980—the option A of the Newmark report.

Mr. **Brown**. That is my recollection in looking at the graph of figures.

What I would like to know is what is this doing to your part of the program? Admittedly, the program encompasses several agencies, and we want to explore that, but your agency has been commended for the research work that you have done in this area. It is directly related to your best capabilities, it seems to me, and what we would like to know is to what degree has this work suffered or not proceeded as rapidly or as broadly as it sholud have and by what degree?

Dr. **Menard**. I would like to comment on one aspect of it in a general way. We may have had adequate funding for the earthquake prediction program in the sense that the directions where we might have plunged in were based on hypotheses or theories that have not worked out.

Our initial enthusiasm for the one method of predicting has not continued, so it might be that we are not too off as far as the basic investigations—just for predicting. Other aspects of the program—that does not apply to—but now we do have one line of approach; mainly, the investigation of strain and drilling into fault zones which are rather expensive programs and which we do not have the funds to implement without just gutting the rest of the programs.

Now it may turn out that that is not the most direct way to go about predicting earthquakes, but it is a method recommended to us by other experts, and it is a method that I don't think we would be able to investigate on at the present time.

Mr. **Brown**. Can you describe briefly some of the other things you investigated that you feel you have adequate information on. I suppose you have looked at things, like, changes in the height of water in wells and things like the release of random gas? Are these part of the efforts that you are involved in?

Dr. **Menard**. Yes; we are involved in all of those. I have a feeling here that I am giving you things slightly second hand, with a first-hand expert sitting here. Now I have been attending a number of meetings. It is not too far from my line of business, and I have been attending the meetings of the Earthquake Prediction Evaluation Council, and we had a meeting in southern California on how our program is doing; but, as a scientist, I really rather would appeal to my expert and so I think I will turn that over to Bob.

Mr. **Brown**. All right. Dr. Wesson?

Dr. **Wesson**. Mr. Chairman, with regard to your previous question about where we are may be falling short of the Newmark report—what areas we feel that we do not have as strong an effort as we would like or we would have planned under the option B of the Newmark report—I would like to begin by saying that, in the initial funding for fiscal year 1978, there was a slightly increased emphasis on earthquake prediction at that time and the long-term plan or the 3-year plan was to, essentially, make that up and have a slightly stronger emphasis on earthquake hazards and risk-assessment studies in fiscal year 1979. When we were, in some sense, derailed from option B of the Newmark report, that compensating increase in hazard assessment did not take place.

Our view is that the highest priority items, which are not currently being carried out and that would have been carried out under the Newmark report option B. would be in the earthquake hazards and risk-assessment area.

Currently, we are working principally in the Western United States, and, of course, in California, in Washington State, in the Salt Lake City region, and also in the Eastern United States in the New Madrid seismic zone, to some extent, in the Charleston, S.C., area, particularly, in collaboration with the NRC—the Nuclear Regulatory Commission—and, to a very limited extent, in the Northeast.

So we would feel that we would need to intensify our efforts, particularly, outside California—in Salt Lake City area, what we call the intermountain seismic zone; in the Seattle region, the Puget Sound seismic zone, and, of course in the Eastern United States.

In the West, of course, geologists can walk along the ground or look at aerial photographs and get a good idea of the geologic structure that may be responsible for earthquakes.

In the Eastern United States, because of the difference in geologic structure and the fact that we are looking at a lot older geologic structures as the possible sources of earthquakes, some subsurface exploration techniques are required, similar to those used in the oli exploration industry and these cost a good deal of money.

Similarly, in the hazards area, we see increased needs relative to our current program that would have been included under Newmark option B. These needs are in the area of the ground failure studies that might be induced by earthquake shaking, the understanding of this ground failure, and the capability to predict it in the event of a big earthquake, and in the capability to predict the magnitude of ground shacking from earthquakes.

Finally, in the hazards area, we had intended under the Newmark report option B to move toward some kind of national data collection system that would be of uniform quality nationwide. Currently, we have a number of regional seismograph networks that are operated principally by universities with help and monetary support from the Geological Survey, the National Science Foundation, Nuclear Regulatory Commission, and others.

We had hoped to be able to make this coverage more uniform—to have uniform instrumentation, at least, throughout the country, and currently we are not able to do that.

With regard to earthquake prediction, Dr. Menard mentioned that we have had some success in exploring a variety of techniques.

I am not sure that we definitely have proved at this point that any of the techniques we have undertaken are fully satisfactory or fully unsatisfactory. We have begun investigations of a number of techniques of the sort you mentioned in your second question; namely, water levels in wells and radon emissions and so on.

To some extent, the problem with the earthquake prediction program is that, in order to truly establish whether any one of these particular techniques is of value in earthquake prediction, one needs a sufficient amount of data over some long period of time including an earthquake, so that one can actually determine what the background variations in the observed phenomena might be and then what the variations prior to an earthquake might be.

So this requires, one, a lot data and, two, some significant earthquakes.

When one is considering a number of different techniques in a number of different regions in which earthquakes might occur, you have, in effect, a limited resource scheduling problem. You have to try and put your resources where you think the earthquakes are going to occur. For example, since the discovery of the southern California uplift in 1975 or 1976 we have been particularly concerned about southern California.

So we have tended to emphasize instrumentation in California, particularly, in southern California; and, within that region, we have a variety of techniques that we are exploring. First, we have a number of seismograph stations, almost 300, extending from the Clear Lake region of northern California to the Mexican border. These are operated by the Geological Survey, by the California Institute of Technology, in cooperation with the Geological Survey, and with other institutions.

Second, we have a network of strain observations. We have two kinds of strain observations, horizontal and vertical. The horizontal strain observations are made on a laser distance ranging device called the geodolite. Essentially, you can set this laser instrument up on top of a mountain peak. You shoot the laser beam some 10 to 30 kilometers away to another mountain peak, laser light is reflected back; and then, by measuring the transit time, you can determine the distance. By flying with a fixed wing or a helicopter along the line of sight, you can make corrections for the effect of temperature and humidity in the air on the speed of light, and thus you can measure that distance to a centimeter or less.

Making measurements of this type over the whole network of lines, one can begin to see the regional pattern of strain—the actual movements of the Earth's crust that we believe are responsible for accumulating the elastic strain which will be released in earthquakes.

This program is, of course, expensive, but we feel the data is very high quality, and these kinds of data are some that give us concern about the situations in sourthern California right now.

I should say that these horizontal measurements are expensive because they are personnel intensive and they can only be done on a survey basis. In other words, we can resurvey each of these lines approximately every 6 months to a year.

We would like to be able to monitor strains in a continuous fashion, in other words, in a real-time fashion. That would give us a better idea about the nature of the changes in strain, whether they are continual or episodic, and we would also be able to—if we were able to effect the economies of scale—get more data over a broader range of space in a shorter time.

We are proceeding with development of a two-color laser device which shoots light in two different colors and, by contrasting the signals in these two different colors, one can make automatic correction for the speed of light due to temperature and humidity. This instrument is somewhat more expensive, and it is not proceeding quite as fast as we might hope; but, once this is done, then we can get out of the survey mode.

We are pursuing vertical deformation studies, principally, by using the classical leveling techniques. We have about 300 to 400 kilometers of lines that are being leveled each year in California.

Again, this is a slow kind of technique, and it does not give us data as quickly or over as broad a regional area as we would like.

So we are trying to develop a number of techniques for measuring strain in a continuous fashion using instruments called strain meters which are long wires or rods that can sense strain changes in the Earth's crust.

Water levels in wells, of course can be used indirectly to sense the strain in the Earth's crust. So we are pursuing development in a number of those kinds of instruments.

In addition, there are a number of things that we do not particularly understand very well—phenomena that have been reported around the world that have preceded earthquakes, and these include, in particular, the radon phenomena that we have mentioned. We currently are pursuing radon studies in less than 10 sites in southern California, principally, through the University of California, San Diego, and Cal Tech.

With each of these—instrumental strain measurements, tilt meters, strain meters, radon variations and water levels, we do not yet understand all the physical phenomena that are responsible for affecting the observations we are making. I do not think we are ready to either make serious predictions based on any of these data or to discard these techniques as being inappropriate. I think they all require further study.

I am sorry. That may be an overly long answer to your question, but we, at this point, have high confidence in the kinds of data we are collecting through prediction studies. We have high confidence in the kinds of data we are collecting through the strain networks, and we have, I must say, a somewhat reduced degree of confidence in some of the other data we are collecting, particularly, for example, in radon. But the chance that it may bring us quite significant information seems to be great and so we are still actively pursuing it.

Mr. **Brown**. I don't have to be a geologist or a scientist to understand that, in order to bring about a capability to predict in this area, you need over a period of reasonable time a network of measurements of the variety which can be correlated with the phenomenon that occurs and that you ought to put your money and resources for developing this data base in those areas where you might expect an earthquake every 10 or 15 years, rather than one every 100 to 150 years. You can spend a lot of time before you got an earthquake.

I understand that the Imperial Valley quake was one of the best instrumented quakes in history, and you, therefore, were able to get a good deal of data. When you can expect some sort of a quake down there fairly often, as well as in many parts of California, it is worth investing some time and effort there.

What we are interested in is do we have a level of effort and resources that are going to give us this observational data base which can be correlated with the phenomenon. I think we need a broad range of data, not only the kinds that are extremely complex—the laser ranging and things of that sort—but things that are amenable to lay observations to some degree. Such data should be observable or amenable to observation by, at least, ordinary engineers or persons concerned with the safety of the population.

Our hope is that a combination of all these things will lead us to some folk wisdom about earthquakes which would be useful. This is the purpose of our questioning. Are you able to continue with the level of activity in terms of achieving a strong data base which will allow you to correlate and to develop the reliable indicators.

I do not expect that you would have them today; but, if you are just going to go through 2 or 3 years of observation and then forget the whole thing, you will never get at the problem.

Dr. **Wesson**. I don't think we are going to go through 2 or 3 years years and then forget the whole thing.

Dr. **Menard**. Mr. Chairman, when the Newmark report came out there was a general naivete in the seismological community about earthquake prediction. I can say that as a nonseismologist.

It was believed that the world was not all that changeable out there. If you could only get the adequate support, which means training students and getting researchers out in the field, and the proper instruments and so on, we could start making observations and it would turn out that some things were changing and those would be indicators of earthquakes.

What has happened is that, if we make more observations, it turns out everything is changing out there. I mean, it isn't just the Earth bulges up. The bulge tilts and it goes back down. It deflates. We thought, when it went up that that was an indication there probably was going to be an earthquake. Now had it been up to begin with and had gone down, we probably would have thought that was an indication of an earthquake. Now we know it does these things, and there has been no major earthquake.

Some of the radon observations seem to be correlated with earthquakes. There has not been a long enough series to be sure, but in southern California a couple of the radon observation points gave a nice correlation with the earthquakes. Others in the same area did not give any correlation at all. Seismologists say that this is true elsewhere in the world—that you can find a good radon well and then it will tell you when there is going to be an earthquake. It takes a long time to be sure which one is the magic well. Moreover, if you don't know why it is giving you these indications, how can you tell if the next time it is going to be right.

Mr. Brown. It is sort of like finding the magic scientist that can give me the answers to the questions that I ask.

Dr. Menard. Well, we have gotten ourselves into a much more complicated world in which no simple change is apt to give us the whole message about when there is going to be an earthqukae. We are still looking for one.

Mr. Brown. It seems to me that this is the essential problem of science. We have to keep accumulating information and building theoretical systems until we find some that confirm each other—that work.

This is, of course, the underlying reason for setting up the earthquake program. It certainly goes far deeper than just wanting to predict when southern California is going to slide off into the ocean.

It seems to me that the earthquake program overall is almost a pontifical case of where we can contribute to the fundamental understanding of the Earth's sciences and knowledge and, in the process, relate it directly to human welfare. This is the reason for having the program.

I think we have a better understanding of the situation now. You feel that you are proceeding, Dr. Wesson, with all of the scientific activities that are necessary to accumulate the data base and to construct whatever theories and systems are going to be necessary to ultimately improve the art of prediction. You are not suffering from any lack of capability in going ahead?

Dr. Wesson. Well, Mr. Chairman, it is to some extent a matter of degree. I think we are currently investigating all the general types of phenomena which may lead to the kind of understanding of earthquakes that we need for prediction. The rate of progress, I think, is what is at issue. It is our feeling that, under the Newmark option B, if we were to have that level of funding, we would significantly increase the number of instrumental measurements, not only made in California, but also in other areas.

Of course, you made the point that it is more expeditious to instrument a region where you expect an earthquake over a relatively shorter period of time than a place where you might have to wait hundreds of years. We have done that by not only investing in instrumentation in California, but by proceeding to install instruments cooperatively with countries in a number of very seismically active places around the world.

We are particularly pleased to say that Dr. Menard this January signed an agreement with the State Seisimological Bureau of the Peoples' Republic of China. Hopefully, within this year, we will begin some cooperative studies in two very active places in China—

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one around Peking, where we have had a number of large earthquakes since 1966, most notably the Tangshan earthquake of 1976, and also in the region of western Yunnan Province in southwest China, where there is an extremely high rate of occurrence of magnitude six earthquakes. By installing some instrumentation in this region, we hope to make very rapid progress.

If we were funded up to option B level of the Newmark Report, we would be making additional investments in foreign instrumentation, not only in China, but in Turkey and in a number of other places.

Mr. **Brown**. How do we share the costs in these sort of agreements?

Dr. **Wesson**. Generally, because the amount of money has not been great, our total investment in foreign earthquake prediction studies is of the order of a million and a half dollars.

We have sought agreement or cooperative ventures with other institutions and in other countries where there is existing capability of manpower and enthusiasm and whereby our provision of some modest equipment existing capability is enhanced.

The Chinese case may be a special one. We have a very detailed arrangement with them. In that case, we will be providing some equipment and some manpower. The Chinese will be providing scientists, engineers, technicians, and logistic support on the ground, and then we will jointly analyze the data.

Generally, this kind of pattern has been followed. We have provided some equipment and technical expertise to a contract with the Massachusetts Institute of Technology to the MTA, which is the geological survey of Turkey. We have made a start to have earthquake prediction instrumentation there.

We have done similar work in New Herbrides which is, essentially on the down-going slab of the Pacific plate. It is a very active region. We have a contract with Cornell University—a cooperative agreement with them—and with a French group called ORSTOM. which is also contributing. So, we have local contributors, university contributors in the United States, and French support in that particular region.

In each one of these cases we have tried to look for opportunities where there is a very high rate of seismicity, some kind of local capability and expertise and interest, and a place where some incremental provision of American expertise and equipment can get us maximum data return.

Mr. **Brown**. Your statement is that, if we had additional resources, this program of international cooperation could be possibly expanded considerably?

Dr. **Wesson**. That is certainly our feeling.

Mr. **Brown**. Let me ask you about the data acquisition program in this country. There is a wide range of activities involved in analyzing data related to earthquakes, not all of which requires a high level of scientific capability and skill that you necessarily have in your organization. In other words, some of it could be done cooperatively with local organizations or other things, and I presume you are doing that to some degree?

Dr. **Wesson**. Mr. Chairman, we have some experience in this area.

For a long time, of course, we have had a program that, whenever there is an earthquake, we collect felt information and, thereby, estimate the intensity which is a measure of the effects of the earthquake.

This is done through questionaires that are sent out to local earthquake observers. This effort has been quite satisfactory and a great deal of the intensity information that is gathered about earthquakes around the United States is gathered through this kind of arrangement with private citizens and lay individuals.

With regard to earthquake prediction, we have made some modest effort to utilize the interest and capability of lay observers but, frankly, we have not been as successful as we hoped we might have been. Of course, it is possible we have not gone about this in quite the right way.

We have undertaken two experiments to date. To begin, we had quite a successful workshop in which we brought together representatives from geophysical and geological sciences, people from the media, people from volunteer organizations; such as, the Red Cross and the Girl Scouts and so on, to discuss how a program might be developed. Thus we have gained some ideas about this. We have tried to implement them through two projects: One, we have a network of water-level observers in southern California that is operating through a contract. These people have what amounts to a club. In some ways it corresponds to the very popular Cat Fish Club in Japan, which is a very successful volunteer effort where people are watching their animals and watching the water level of wells and reporting into a central agency.

Ours is a somewhat smaller-scale effort. It has had some success.

Another effort that we have undertaken, which combines volunteer and lay observation with another aspect of earthquake prediction; namely, the possible anomalous behavior animals. We have had contract with the Stanford Research Institute, and they have organized a network of people who observe their animals. Once a week they are supposed to call into a telephone number and report what their animals are doing: and, if they see any kind of anomalous behavior, at any time between routine calls, they are to call in and let us know. In this way, we can accumulate some data base that determines whether these animals are actually behaving anomalously.

Unfortunately, there seems to be a human tendency for these people generally to call up after the earthquake and report that their animal did, indeed, do something strange. Under this program, that is not allowed. You must call up before the earthquake to get a positive record.

So we have made some effort in trying to involve lay observers.

I am not personally satisfied with our results to date. It may be at some future time when we have a more clear idea exactly where measurements to be made and exactly the best way in which to make them that we could use lay observers in a more efficient way.

We are making some effort, but we are not satisfied with the progress.

Mr. Brown. I would like to get a little more precise understanding of this. Maybe you could supply for the record the amount of funds you have expended on contracts in the earthquake prediction field involving lay observer observations of earthquakes.

Dr. Wesson. As of fiscal year 1980, we have spent approximately $200,000 on contracts dealing with the collection of earthquake prediction data from lay observers.

Mr. **Brown**. I am likewise interested in the degree to which you contract out for other kinds of technical data. For example, I think that one of the community colleges in my district has been making observations of magnetic anomalies, along the San Andreas Fault. This is something that can be done on a fairly unsophisticated level. I don't know with what degree of accuracy but, presumably, there are a lot of local technical people who are competent to aid in collecting observations of this sort. I would be interested to know how much of your resources are going into this kind of program.

Could you provide that for the record?

Dr. **Wesson**. Yes, we can provide that for the record. I can say very roughly right now, to provide some constraint on our discussion, of the approximately $32 million total program, including prediction, hazards assessment, seismic information, we have contracts, principally, with universities and other technical groups, totalling about $8 million or, perhaps, a bit more.

Additionally, we contract for technical services, for surveying, and for drilling, and other types of things that add up to an additional several million dollars.

The total effort in lay observations is quite modest. I don't know exactly what that figure would be, but it is, I would say, less than $200,000.

We can supply that in detail.

Dr. **Menard**. We would welcome the opportunity to broaden the program. Really, the principal long-term concern that I feel, and I think is widely felt, is that we will make some false predictions almost inevitably because we don't completely understand the phenomena we are dealing with. We will have the responsibility to predict at some point, if we will feel that the data look pretty good, and then nothing will happen. If we would thereafter develop an accurate ability to predict, then nobody would believe us. So the more people we can get involved in this program that realize the complications and so on, the better off the whole thing will be for the country. So we would like to develop a widespread appreciation for the problem of earthquake prediction.

In China, you have millions of people involved in the program. They personally realize that there are uncertainties in it because of their own observations, and then their families know about the uncertainties and so on.

As Rob said, we have not figured out a way for people to make many meaningful observations, except with animals and water level, perhaps. We don't like to associate ourselves with a program in which people are making meaningless observations.

Mr. **Brown**. If you will permit me, I am going to suggest a model here which I think is important and, in which to some degree over time, would help to alleviate this situation.

I think the public interest and participation in science and matters related to science is always enhanced as the public become involved in things that they can see as being important to their own lives.

I conceive of earthquake phenomena in California as being one of those things that is important to people's lives; and, to the degree to which you can get local organizations, including governmental and educational, interested in that, it is going to stimulate their interest in a whole range of earth sciences and related matters.

They are going to want to understand what makes earthquakes. You are going to get more interest in geological courses in high schools and colleges. You are going to find local people, and it may, as I say, be organizations, like the local county surveyor or the local college courses, wanting to relate some of their learning activities to a real problem like that. I am not saying that this is necessarily your job, but it is part of the general job of science, which I have a great deal of difficulty sometime in convincing scientists to encourage of modes of procedure which will facilitate this. Hence, I think, it is very important that you involve local organizations in these kinds of activities Everyone will benefit from it.

A local consulting engineer with his survey crew is going to feel a little prestige rubbing off on him if he can cooperate with your organization and something that is within his capability.

Your local geology classes at the State college are going to feel the same way.

If we don't go about it in this fashion of each taking a share of the concern for the disseminating of knowledge and the creating of awareness, we are going to end up with the most God-awful bureaucracy in the world and still not achieving certain fundamental public purposes. We would like to avoid this; wouldn't we?

So this is why I stress these aspects of it. Incidentally, I think, the Chinese are way ahead of us. Of course, they have a horrible bureaucracy over there, too, but maybe we can do better than the Chinese.

Dr. MENARD. Also, the Chinese can order a million people out of the city, and the people will go out of the city. They will come back when they are ordered, and then go out the next time. I don't think free American citizens would go out the next time. That's why we don't want to make any more mistakes than we have to.

Mr. BROWN. We are going to yield to the capable staff for a couple of questions.

Dr. ZIMAN. Thank you. I have about three questions, and then I will pass on to somebody else.

Dr. Menard, in your testimony on pages 9 and 10, you refer to the changes in strain patterns in southern California. I am just wondering whether or not you can make any comparisons between this and what was observed down in El Centro before that earthquake and after the earthquake?

Dr. MENARD. I don't believe there were any comparable observations. As Rob described—well, in the first place, you don't have the radio-astronomy observatory. You have to go down into that area and, in the second place, you don't have the laser surveys.

Is there any way you can measure that?

Dr. WESSON. Well, we have, in the program of laser measurements that I talked about, networks that follow more or less continuously from the San Francisco Bay area to the Mexican border. They do not quite go to the Mexican border and they do not quite include the region of Imperial Valley where the earthquake occurred, but one of the networks, so-called Salton network, is located just to the north and to the west of the Imperial Valley. It swings from the Salton Sea around to the west. Those measurements are made between 6 months and 1 year's spacing. From the measurements that were made approximately 1 year ago in the Salton network, we saw a significant change from the normal pattern. We had been seeing on these networks—in most cases we have data going back to about 1973 or 1974—a pattern of north/south contraction all over southern California, that is, the Mexican border is getting closer to the Tehachapi Moun-ains.

Beginning with the measurements that were made about 1 year ago, we began to see east-west expansion as well.

Dr. **Menard.** In the Imperial Valley?

Dr. **Wesson.** On the northern and western margins of the Imperial Valley, in the Salton Sea, very close to the Imperial Valley. The prob-em is that the Imperial Valley is very flat, and you can't shoot across he whole valley. The only way you can make measurements is to build a big tower in the middle of the valley and then shoot out.

Mr. **Brown.** You are undoubtedly familiar with the fact that 50 to 5 years ago they confronted the problem by setting up a station on what they call Mount Signal, which is across in Mexico, if I recall it orrectly.

Dr. **Wesson.** Every once in awhile, we have to apply for permis-ion from the Department of the Interior to leave the country to close ur networks with stations in Mexico. I wouldn't be at all surprised that station is included in the western part of this network.

In any case, in the Salton network, about 1 year ago, we saw an nomaly. We were not sure it was an anomaly at that time, but it ow seems clear to be an anomaly.

We saw similar anomalies in other networks going northward from his Imperial Valley toward Palmdale.

The Imperial Valley earthquake occurred in October. It is difficult make the argument that this phenomenon we saw 1 year ago should e considered any kind of short-term precursor to the Imperial Valley rthquake.

However, I think, we are coming to the conclusion or, at least, our ndency in thinking is toward the idea, that we have seen over the st year an episode of tectonic activity that has covered much of uthern California, in fact, much of the southern two-thirds of Cali-rnia. Within that time period, we have had a large number of mod-ate earthquakes—moderate-to-large earthquakes.

The number of the earthquakes is significantly larger than what we e in any typical year. These include, of course, the largest one in the nperial Valley earthquake in October, the Coyote Lake earthquake August, the Livermore earthquake in January, and a number of rthquakes between the magnitude of 4.5 and 5 level, including the rthquake southeast of Hemet on Monday.

We have had a period over the last year or so of somewhat height-ed seismicity at the moderate earthquake level in the southern o-thirds of California.

At the same time, we see these changes in the strain pattern. We w the same tendency that we saw in the Salton network in what we ll the Palmdale network, which is a network located near Palmdale he change we saw there was not a year ago, but was this fall. It was veral times larger than the Salton change, and it was corroborated, t only by the laser distance ranging but by measurements using the VLBI system used by NASA at the Jet Propulsion Laboratory, with whom we have been in close contact on this matter.

So we have seen a whole pattern of strain changes and a whole sequence of earthquakes over southern California. While we are not prepared to say yet, that there is a definite cause-and-effect kind of relationship or that these are in fact the two effects or two symptoms of the same underlying process. I think there is a good deal of thinking that is going in that direction.

Dr. Ziman. Would you term that high concern, as well?

Dr. Wesson. Well, this is of great concern to us. The changes in strain phenomena that we have seen over the last year are significant and large compared to the kind of anomalies that we have seen over the period of measurements, which is now about 8 years. Unfortunately, we don't know what the normal variation is. If our measurements went back for 50 or 100 years and we could say, yes, this is anomalous compared to this whole time span, then we would be very concerned.

We don't have that background of record, so we don't know quite how to interpret this.

Similarly, we don't have a satisfactory physical model for interpreting these data.

So, yes, these measurements, particularly, the strain and, also, the radon and the frequency of earthquakes over the last year in southern California, causes a great deal of concern that yet another effect of this possible tectonic episode would be a large earthquake. We are trying in every way we can think of to test that hypothesis; but, at the current time, we simply do not have an understanding either of the variations within the data that we see or an understanding of the causes of these variations to make any kind of prediction.

Dr. Menard. Initially, you asked whether there was any difference between the Palmdale area and farther to the south. There is tectonically a difference, and that is that the region is generally under compression, which we more or less understand because of the way these plates are moving around. In the transverse range area south of Palmdale the San Andreas fault bends off to the east, you get a compression that by general expectation might tend to lock the fault.

In the Imperial Valley, where the fault is sort of tending more northerly, a compression is apt to cause it to slip.

If you relieve this compression and start getting tension down in the Imperial Valley area, tectonically, this would have quite a different effect from what it does in the transverse ranges where things begin to unlock, and you might feel much worse off, and you do feel worse off.

Dr. Ziman. In the area of prediction, you have established the National Earthquake Prediction Evaluation Council, and it is their responsibility to validate predictions; and, then if they do so, it is your responsibility after that.

What are the ramifications right now? Are there any problems with issuing a prediction as you see it. Are there any problems with any other agencies, and are you trying to straighten these things out?

Dr. Menard. There are problems in issuing predictions. We believe we have the authority to issue predictions under our enabling act, but the matter is in dispute. Consequently, it is not at the moment clear until legislation is enacted—that we can issue predictions without putting the Government under liability.

Dr. **Wesson**. I might just expand on that a bit. The Disaster Relief Act of 1973, I believe, contains a clause that says the President shall issue warnings of natural disasters—I don't remember the exact words.

We were under the impression that the authority for geologic-related hazards had been, in effect, delegated to us. There has been some disagreement among the solicitors in the Interior Department who believe that we do have that authority from that act and, also, from the Geological Survey Organic Act and the attorneys in other parts of the Government representing other agencies.

The Geological Survey has asked the Department of the Interior, and the Department of the Interior has agreed to propose legislation that would clarify the situation once and for all.

In addition to clarifying the role of the Geological Survey and issuing warnings of geologic hazards, it would also try to resolve the question of liability for the Federal Government and Federal employees as a result of a prediction or a nonprediction. Finally, it would clarify and enable us to operate somewhat more efficiently with the National Earthquake Prediction Evaluation Council in the context of the Federal Advisory Committee Act.

Now those legislative proposals have been prepared by the Geological Survey and supported by the Department of the Interior, but they are currently under examination by the Office of Management and Budget. So the administration has not yet decided whether to support those proposals.

Dr. **Ziman**. This raises one other question, and I guess it is also with regard to lead-agency concept. The comments I have heard in talking with municipalities is that, if an earthquake prediction is issued and a time frame is given, for instance, 6 months, 6 years, 6 weeks, they, in trying to formulate their plans, want to know how to set their priorities in order to respond. Whose responsibility would that be to tell them or give them these ideas? Is that FEMA's?

Dr. **Menard**. What do you mean by priorities?

Dr. **Ziman**. How would they respond? What would they do to mitigate it, given the time frame there?

Mr. **Brown**. In other words, if the earthquake is going to come a month from now and you predict it, do you evacuate today or do you wait 2 days before the earthquake occurs?

Dr. **Menard**. The first thing we do when the survey decides there should be a prediction is to inform people and inform the Governors of the States affected. We have no authority or responsibility in any way over the actions taken in response.

Am I wrong on that, Rob?

Dr. **Wesson**. Well, I just want to expand a bit. Prior to the formation of FEMA, there was, frankly, at least in my view, a vacuum in the predisaster phase of any kind of disaster. The former Federal Disaster Assistance Administration was very reluctant to take any role in that area. We were optimistic with the formation of FEMA that we would finally find a partner that we could work with in developing Federal response—if I could say that—to a prediction of some sort. We are still optimistic that that will take place.

FEMA has really only been on the ground and operational for about 6 or 8 months now. The signals that we have gotten from them indicate that they are still very much interested in this. But we, as the people who fairly clearly have the responsibility of making the prediction are asking what is going to happen next? Although our principal area of expertise and responsibility is on scientific and earth-science aspects, we as humans and as responsible individuals cannot walk away. So we have taken a number of steps to try and get a process in motion that would develop the kinds of mechanisms for communication and response and advising about priorities to communities, but we really need the full support of FEMA and other Federal agencies.

Dr. MENARD. We have tried to communicate with people organizationally in all levels of government just in order to get as widespread an appreciation and participation in this program; but, with the formation of FEMA, we really do not have any responsibilities beyond that level nor do we have any authority.

I have talked to the FEMA people and officials, and they expect to take over responsibility whenever any prediction is issued.

We cannot, for example, take any steps to mitigate any other natural disaster hazard that we predict.

Dr. ZIMAN. I have no further questions, Mr. Chairman. Mr. Brown. Thank you.

Do you have any questions, Mr. Scoville?

Mr. SCOVILLE. Let me just state a couple of questions and, perhaps, you can answer for the record because I think we are a little bit short on time.

First of all, it is my understanding that there are some seismic observation stations in the Soviet Union north of where the Indian subcontinent is—essentially moving into the Asian plate.

In the changed political environment, if there ia any danger that that program will be disrupted. About what is the cost of that program; if you could answer that for the record.

Answer. Under the U.S.-U.S.S.R. Earthquake Study Area of the Joint Environmental Agreement, a network of seismometers has been established in the Garm region (Tadzhik) of the U.S.S.R. This network has been established to study the local seismicity in the region and to look for seismological evidence of impending large earthquakes. The network is operated by the Soviets with periodic visits from Geological Survey scientists to maintain the network and analyze the data. The next scheduled visit of U.S. technicians is in late 1980. We do not know at this time if they will be allowed to make the trip to Garm; however, we have not received any negative signals from the Soviets. The cost of the project is about $80,000 annually.

The second question I would like to know is the National Science Foundation is proposing a program of ocean-margin drilling using the Glomar Explorer. I would like some thoughts from your perspective of the basic earth sciences as to how much that program might contribute to the geological understanding that you need to start making earthquake predictions and whether or not any sort of new fundamental knowledge of geology could also be obtained with the other alternative, which is basically a continuation of the current Glomar Challenger program.

In other words, if that program has to justify itself, it has got to be of use to more people than just the National Science Foundation. I would like to have some idea how that would help.

[Material referred to follows:]

Answer. The Glomar Explorer should make a significant contribution to our understanding of the ocean margins plate tectonics, and the formation of continents and ocean basins. We doubt if data from the Glomar Explorer will have any direct impact soon on the earthquake prediction program, although it should cast new light on the tectonic processes that eventually lead to earthquakes. In our opinion the Glomar Challenger will not provide the data possible with the Glomar Explorer; however, we reiterate our pessimism regarding the early and direct impact of data from the latter on earthquake prediction research.

I guess the one final question I would like is—you were discussing the uncertainties involved in the Palmdale event. One of the questions that concerns me is whether anybody is doing—what sort of policy statements you can make at any given level of uncertainty. Like, for instance, it strikes me that this problem is somewhat analogous to the issues that you face in the greenhouse-effect problem, where the scientific knowledge is uncertain but, at any given stage, there might be policies, actions, that you should be taking given the degree of knowledge, even if you don't have this 100-year record, to know whether this is an anamoly or whether this is within the normal variations. What prudent steps ought one to be taking? I guess I would like to know from you all, and I will ask Dr. Sanderson the same question, is whether anybody is doing any research or making any attempt to try to layout what would be the prudent steps to take at this level of knowledge, sort of developing a better methodology for this type of decisionmaking under uncertainty?

Those are my questions, Mr. Chairman.

If you could answer them for the record, I would much appreciate it.

Dr. **Menard**. We will put them in the record.

[The material referred to follows:]

Answer. We agree that research should be conducted to quantify the gray areas between a specific prediction and no comment at all. One approach is to cast earthquake predictions in terms of probabilities much like the chances of rain are stated in routine weather forecasts. Some modest efforts are now being made within the earthquake research community to develop the methodology for probabilistic statements on future earthquake occurrence. We are attempting to support and build on these efforts.

Mr. **Brown**. Do you have another question, Dr. Ziman?

Dr. **Ziman**. Yes; may I please. I would like to just ask one more question with regard to funding. I know you mentioned your funding situation, but certain things strike me with regard to this. One is in terms of finding earthquakes, you mentioned that you have international agreements and, also, you have to go where the earthquakes are. Are you finding restrictions in being able to go outside the country and, if so, what are they? At the same time, you are also being asked for more information by the public in, at least, two areas—one is hazards assessment and another one is probably in responding to earthquakes through your network branch. Are you having a strain on your finances to respond to the increased need or demand that is being put on these things and what can you do about that?

Dr. **Menard**. Would you like an answer directed toward that now or do you want to put that in the record, too?

Dr. **Ziman**. It depends on how long or short it is.

Dr. **Menard**. I can give you a short answer about the traveling part, and that is that we are having considerable difficulty because of travel restrictions. It is simply that we have no way of telling how many earthquakes there are going to be and where. We have a large amount of field work involved in our programs. The general traveling restrictions touching overall reductions in travel, also, affect our fieldwork and that is giving us a great deal of difficulty. We can spell it out for you later.

Mr. Scoville. May I ask a question in this connection, Mr. Chairman?

Mr. Brown. Yes.

Mr. Scoville. Last Friday, you may have seen an article in the New York Times, which said essentially that the Department of Commerce prohibited a couple of Soviet scientists from attending a convention of the American Optical Society—I think it was in San Francisco, but maybe not—on the grounds that this would involve the transfer of potentially sensitive technology just by attending this meeting, and it was a public meeting.

What I would like to know—obviously, you talked about the use of these laser rangefinders and that sort of technology—is there any worry on your part that these policies which are apparently being set by the Department of Commerce would inhibit contact between individual scientists, in the Soviet Union and in the United States, quite aside from the network I was talking about earlier, but whether there is any worry that administration policies will restrict the flow of ideas and contacts between individual scientists in these areas?

Dr. Menard. Well, we've gone beyond that now. The National Academy has terminated for 6 months its exchange program to the Soviet Union. Practically every funding source that I know of for exchange programs with Russia is now shut down.

As far as communications—letters, exchange of reprints, exchange of data—I don't know any restriction on that.

Mr. Scoville. It is getting very close to it. In connection to one case, I think it was in connection with another conference, the Department of Commerce actually made the foreign participants sign pledges that they would not communicate information back to the Soviet Union, which is getting awfully close to censorship. I wanted to ask you whether you were at all concerned about the possibility of this type of restriction upon your activities, at least, in terms of basic communications between scientists, irrespective of the funding sources?

This seems to be this is sort of an adjunct of what Dr. Ziman was asking.

Thank you, Mr. Chairman.

Mr. Brown. Gentlemen, I think we will suspend further questioning of you at this time, in view of your own schedule situation. I want to thank you very much for being here and helping to clarify the progress in the earthquake program, which we are very much interested in, and we will look forward to further responses from you on the questions that we have submitted.

Thank you very much.

Dr. Menard. Thank you.

[Additional questions and answers for the record follow:]

## USGS Earthquake Program
## Reauthorization Hearings

Question #1: How does the USGS relate to FEMA with regard to the earthquake program? What is being done to define that relationship?

Answer: The USGS assumes FEMA will adopt or will be assigned the role of "lead agency" to "stimulate and coordinate earthquake hazards reduction activities in the Federal Government and throughout the Nation" These quotes are from the National Earthquake Hazards Reduction Program implementation plan published by the Executive Office of the President. A Memorandum of Understanding is being developed between FEMA and USGS to define the specific responsibilities between the two agencies within the earthquake program.

Question #2: The budget for USGS earthquake research has remained fairly constant over the past three years. How has this affected your programs in general? Are there any particular areas that have been hurt by this? Is there any area that could substantially benefit from an increase, for example the Network Operations Branch? It is our understanding that USGS has inherited some DoD seismographic instrumentation. Has there been any increase in budget to fund the expanded network?

Answer: The USGS earthquake program funding level has remained approximately level during the past two years, except for pay cost supplementals. The effect of inflation has been seen to reduce field studies and equipment installation. Additional funding would be used in the earthquake hazards and risk assessment area of the program. Funding would be applied to accelerating earthquake hazards assessments in the Salt Lake and Seattle regions, to research on the causes of earthquakes in the eastern United States, to expanding earthquake-induced ground failure research, and to establishing a reliable national earthquake data base. In FY 1980 the USGS assumed operational responsiblity for a network of digitally recording seismographic installations at worldwide stations. These stations had been installed by the USGS with full support from the Defense Advanced Research Projects Agency. The annual cost of operating this network is approximately $700,000. There has been no budget increase to fund the operation of this expanded network.

Question #3: Can you tell us what progress has been made in the various parts of the USGS earthquake program?

Answer: Yes. Our progress in each of the four main elements of our program is outlined below.

Earthquake prediction. Extensive geophysical and geodetic measurement networks have been installed along active faults in California and elsewhere; laboratory studies have given new insights into the rock failure process, and direct measurements have been made of the state of stress at shallow depths in the Earth's crust. Although none of these activities have yet resulted in a comprehensive, widely accepted model for earthquake predictions, they have, along with recent observations in California, given us a strong body of data with which to work.

Earthquake Hazard and Risk Assessment. Important progress has been made in determining the cause of earthquakes in the upper Mississippi embayment, estimating the recurrence rate of earthquakes along major faults, developing national and regional probabilistic ground shaking maps, and in obtaining strong ground shaking data for use in earthquake-resistant building design.

Induced Seismicity. From studies of the seismicity associated with the filling of reservoirs in South Carolina and the USSR we have made significant advances in our understanding of the nature of reservoir-induced seismicity and in the development of techniques that may be used to estimate the hazard of this phenomenon. Specifically, in South Caroliona, stress measurements made in wells that penetrate the seismic zone imply that the cause of the seismicity is due primarily to reservoir loading and not due to a broad regional stress pattern.

Earthquake Data and Information. Our earthquake data services have improved and become more timely over the past year and a slow but steady modernization of these services continues. In FY 1980 we assumed operating responsibility for the Global Digital Seismic Network established by the Department of Defense.

Question #4: What is the state-of-the-art for earthquake predictions? What types of predictions are we capable of making now?

Answer: There is no complete, well-accepted model, technique, or theory for earthquake prediction at this time. Although several successful predictions have been made, with notable results in China, they have been based on anamolous seismicity and geophysical measurements without a strong understanding of the physics involved. Of course, a breakthrough may be possible at any time, but at present and in the near future we will probably be restricted to statements reflecting increased concern or general warnings without specific predictions of the precise time and place of damaging earthquakes.

Question #5: Could you address the California situation, especially your concern with the consequences of making a prediction in that area.

Answer: Within the past year there have been disturbing changes in seismicity patterns, geodetic measurements, and geochemical observations in the southern California area. It is possible, that say within a year, additional changes will result in the issuance of a statement concerning the likelihood of an earthquake within a general area over some span of time or until the geophysical measurements return to normal. Our concern is over the lack of Federal, State, and local preparations to act on, and the lack of public education on how to react to such a statement.

Question #6: What are your responsibilities in the prediction area? Are you responsible for making assessments of naming priorities for mitigation for local communities for which the prediction is issued? Are there any problems regarding your authority to make a prediction? What laws/acts must be modified so that you have the necessary authority? What is your legal responsibility for making a prediction?

Answer: Under the National Earthquake Hazards Reduction Program Implementation Plan prepared by the Executive Office of the President the Geological Survey has the responsibility to "conduct research on the nature of earthquakes, earthquake prediction, hazards evaluation and delineation, and induced seismicity" and to "evaluate, with the advice of the National Earthquake Prediction Evaluation Council, earthquake predictions.". The Implementation Plan further states "the responsibility for evaluating and communicating earthquake predictions and other information of this type will rest with the Director of the U.S. Geological Survey. To resolve questions of liability additional legislation may be proposed. The Director will be assisted in this task by the National Earthquake Prediction Evaluation Council, a Council to be composed of scientists from inside and outside government. This Council will be established in 1978. The responsibility for warning the people about imminent danger from a natural hazard and to advise or direct them how to respond is principally a function of State and local government.". Thus we see our primary responsibility in the development of reliable means of earthquake prediction and in the evaluation of predictions.

The Department of the Interior has proposed legislation to clarify the authority of the Secretary of the Interior, exercised through the Geological

Survey, to issue warnings of geological hazards including earthquake prediction; to exempt the Federal Government and its employees from liability for the consequences of such warnings or the failure to warn, and to exempt the National Earthquake Prediction Evaluation Council from the requirements of the Federal Advisory Committee Act to hold open, pre-announced meetings. These legislative proposals are currently under review at the Office of Management and Budget.

Our legal responsibility for making earthquake predictions is based on Section 1 of the Act of March 3, 1879 (the Organic Act for the Geological Survey, 43 U.S.C. 31(a)), Section 202 of the Federal Disaster Relief Act of 1974 (42 U.S.C. 5132), Section 5 of the Earthquake Hazards Reduction Act of 1977 (42 U.S.C. 7704), and the Implementation Plan quoted above.

We are assuming, at present, that our legal liability for predictions made or not made is the same as that of the National Weather Service regarding weather forecasts and predictions.

Question #7: Describe the need for and problems with your international efforts. Are there major international cooperative efforts in this area of research?

Answer: Because other seismic regions of the world offer opportunities to study earthquakes and because other countries have vigorous earthquake research programs, we are engaged in several studies in foreign areas and in formal cooperative research activities with foreign countries. Our principal cooperative efforts are with the Soviet Union, under the US-USSR Joint Committee on Cooperation in the Field of Environmental Protection, and with the People's Republic of China, under a protocol between the USGS, NSF, and the PRC State Seismological Bureau signed in Beijing in February 1980. Other areas of foreign research are in the New Hebrides, Turkey, and Central America; however, our primary foreign activities are in China (PRC) and the USSR.

Question #8: Are there problems in the funding of the Seismic Engineering Branch?

Answer: In our opinion the funds provided by the National Science Foundation for seismic engineering studies are not adequate to perform the work required. This activity is chiefly concerned with the deployment of strong-motion instrumentation, the maintenance of that equipment, the management and dissemination of strong-motion data, and data analysis. These instruments record only the strong, and often damaging, ground and structure motion from earthquakes. It is the primary source data used by engineers in the earthquake-resistant design of buildings and critical facilities, such as power plants and multi-story buildings. Thus, the data influence decisions that affect public safety and local economies.

Question #9: How does underfunding of policy research affect the EHRP?

Answer: Policy research is an area mandated to the National Science Foundation under the Earthquake Hazards Reduction Act of 1977. The specific ways that funding may limit the scope of investigations or the attainment of goals can best be addressed by NSF. However, it is clear that the progress of policy research does affect the hazards reduction program. The fundamental point is that technical information is of maximum benefit to the public only if the distribution and use of the information is guided by a well-designed policy. Many examples can be cited. The success of USGS efforts in fault mapping or measurement of strong ground motion is meaningless in terms of hazard reduction if the scientific results are not properly applied in zoning considerations, or engineering design specifications. The issuance of an earthquake prediction by the USGS in the absence of a well-developed response policy could cause economic and social damage to affected areas. Legal liability is unclear for individuals and institutions that provide or withhold prediction or hazard data. In short, physical-science research results from the Earthquake Hazards Reduction Program can be applied, or misapplied, with direct, strong economic and social consequences. It would, therefore, be prudent to support research to formulate policies that make these consequences beneficial to society.

Question #10: **What is the weakest link in the EHRP and what can be done to improve the situation?**

Answer: **The utilization of research results from the Earthquake Hazards Reduction Program seems to be the least well-developed aspect of the Program. The physical-science components are proceeding according to reasonable schedules and are providing much useful data. New results from the Hazards Assessment element can be applied immediately to zoning and building code determinations, with clear economic consequences. Earthquake prediction is still very much in the evalauation stage, but proceeding, and there is a possibility that a credible prediction could be made at any time, again with economic and social consequences. Compared to the progress being made in assessment and prediction, there seems to be some confusion as to responses to hazard evaluation or prediction, on a Federal, State, county, city, and individual level. Studies have been carried out with available funds, and the National Science Foundation can no doubt supply data on the current state of research in implementation and make suggestions as to levels of funding required for goals to be attained in a timely way. It is clear from the widespread interest in USGS earthquake information conferences that public officials are ready to cooperate in utilization of results from the Earthquake Hazards Reduction Program. The development of the data and theoretical concepts that make utilization possible is worthy of support.**

Question #11: Given budget limitations, how well can USGS respond to demands for increased hazard assessment information?

Answer: If the hazard assessment program is level-funded, no significant increase in rate of information produced by the program is possible. Information concerning hazards in areas not currently under investigation can be obtained only by redirecting efforts from other areas under active study.

In fact, some of our earthquake hazard assessment studies must be reduced under budget limitations. For example, seismometer networks and data analysis are relatively constant operational requirements that demand increased funding support in an inflating economy. Within the given budget limitations these activities must either be curtailed or supported with resources redirected from other research efforts.

Mr. Brown. Our next panel will report to us on the role of the National Science Foundation, in connection with the earthquake hazards mitigation program. We welcome Dr. Sanderson and his colleagues here this morning to give us a picture of what the foundation is doing in this area.

You may proceed with your statement, Dr. Sanderson, in full or in part. The full text will be included in the record at this point.

## STATEMENT OF DR. JACK T. SANDERSON, ASSISTANT DIRECTOR FOR ENGINEERING AND APPLIED SCIENCE, NATIONAL SCIENCE FOUNDATION

Dr. Sanderson. Thank you, Mr. Brown. I would like to put my full statement in the record. However, in the interest of time, I will simply make a few brief statements.

Before I do that, I would like to introduce Dr. Johnson, who is accompanying me this morning, to describe the atmospheric, Earth, and ocean sciences part of the program.

Each of us has, on our outside arm, the people who are actually responsible for making these programs work and who will probably be in the best position to respond to any of your questions.

Rather than give my testimony, I simply would like to say I could approach the description of the program that NSF is running in earthquake hazards mitigation basically from two directions. One approach would be to describe some of the areas impacted. These areas range from the examination of some of the social and legal barriers that exist, such as in the San Francisco Bay area, that make it difficult for the State and local officials, even if they believe an earthquake is imminent, to respond effectively; to research that can contribute significantly to land-use planning, particularly, the development of microzonation techniques; to research to improve design capability for new construction, which has led, with the cooperation of a number of organizations, to the development of new model building codes; to the start which we are beginning to make on understanding some of the problems of retrofitting and reenforcing structurally damaged construction. There is also a beginning in understanding some of the issues that are involved in our increasing likelihood of being able to predict a disaster.

Another way to approach this program is to begin to describe some of the areas of research that we are currently supporting. I would break this for simplicity into three major categories: One major category is in the area of geotechnical engineering. We are now, beginning to understand the nature of strong ground motions, the way they propagate through the Earth structures, and the way they add or cancel each other at a particular site. Second, we are studying the way that those shock waves couple into the man-made and natural structures which are located either inside or on the Earth; third, we are beginning to understand some of the problems in structural materials subjected to dynamic loads and the ascismic design of structures.

When the Foundation began its program in the sixties, all designs were based on static-loading criteria—simply applying a static force to a building, as an approximation of the earthquake loading forces.

We learned very quickly through a number of disasters that that did not work.

We are now beginning to make real progress in moving from static to dynamic loading. Coupled with our understanding of shock wave propagation which has now made it possible, at least in some cases, to duplicate theoretically the seismic pattern in a given location and the experimental and theoretical models which are developing, we are beginning to understand some of the problems involved in designing structures and are developing computer codes for the dynamic analyses. Those codes are now very widely used. They are a significant element in the design of all highly significant structures from a seismic point of view—dams, nuclear powerplants, other structures where the risk of disaster is extremely great.

Finally, our socioeconomic and policy research program which examines behaviorial responses, both at the individual and organizational level, looks at some of the socioeconomic barriers and organizational structures related to land-use planning, and other human responses in the presence of an anticipated disaster.

In the testimony and in the supplemental materials which we supplied you earlier, which I would like to have as part of the record, we have described significant progress in all of these areas of research.

What I would like to emphasize this morning is that there are tremendous opportunities for further research in a number of these important areas.

We have outlined some of those areas in the future program plan which you have received from us. Another important factor is the high degree of international cooperation which is developing in this program area. There are a number of countries—Japan, Peoples Republic of China, Taiwan—where both we and they stand to benefit from this cooperative research. Within the past 2 years, we have reached two major agreements in cooperation with very seismically active parts of the world.

I would just conclude by saying that this research, like all of the problem focussed and the applied research in NSF, must pay particular attention to utilization.

I know in testimony, yesterday, you had some discussion of problems of information transfer, communication to the public.

NSF has been placing its attention on transferring information to the people who will need and can use it directly in their policymaking decisions and activities.

In fiscal year 1980 we are going to spend slightly over a million dollars on activities that could be described as technology transfer—to engineers, who are using the computer codes and the design concepts for structural design—to other research scientists and engineers who are entering the field or who are starting significant projects and, very importantly, to government officials, financial markets, people who are making policy with regard to land use, and to public organization in potential earthquake areas.

[The prepared statement of Dr. Jack Sanderson is as follows:]

# STATEMENT OF
# DR. JACK T. SANDERSON
# ASSISTANT DIRECTOR FOR ENGINEERING AND APPLIED SCIENCE
# NATIONAL SCIENCE FOUNDATION

BEFORE THE

SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY
OF THE COMMITTEE ON SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

FEBRUARY 27, 1980

MR. CHAIRMAN AND MEMBERS OF THE SUBCOMMITTEE:

IT IS A PLEASURE TO REPORT TO YOU ON THE PROGRESS AND FUTURE PLANS OF OUR EARTHQUAKE HAZARDS MITIGATION PROGRAM. AS YOU ARE AWARE, NSF INITIATED RESEARCH ON THIS IMPORTANT NATIONAL ISSUE IN THE MID 1960'S. THAT EFFORT BEGAN WITH MODEST DEVELOPMENTS TO IMPROVE SEISMIC RESISTANCE IN BUILDINGS. SINCE 1966, WE HAVE OBLIGATED NEARLY ONE HUNDRED MILLION DOLLARS FOR RESEARCH IN ENGINEERING AND, TO A LESSER EXTENT IN ARCHITECTURE AND THE SOCIAL SCIENCES, TO DEVELOP THE KNOWLEDGE BASE NEEDED TO EFFECT CHANGES FOR THE BETTER IN THOSE PARTS OF THE COUNTRY THAT ARE SUBJECT TO POTENTIAL LOSS OF LIFE, PERSONAL INJURY AND PROPERTY DAMAGE FROM EARTHQUAKES.

WE ARE MAKING CHANGE COME ABOUT. FIFTEEN YEARS AGO, BUILDING DESIGN PROCEDURES WERE PRIMARILY SIMPLE EXTENSIONS OF STATIC STRUCTURAL COMPUTATIONS - COMPUTATIONS WHICH ASSUMED THAT THE BUILDING WAS NOT IN MOTION AS THE SEISMIC SHOCK WAVES, PROPAGATING THROUGH THE GROUND, DISPLACED THE BUILDING'S FOUNDATION. WE ALWAYS KNEW THAT THIS ASSUMPTION WAS NOT TRUE BUT WE HAD NEITHER THE ANALYTICAL METHODS NOR THE COMPUTATIONAL MACHINERY TO MAKE A BETTER APPROXIMATION. FROM THAT STATE OF AFFAIRS, WE HAVE PROCEEDED TO THE PRESENT CAPABILITY, IN WHICH DYNAMIC ANALYSES ARE AVAILABLE THAT CAN PREDICT THE ELASTIC RESPONSE OF A GIVEN STRUCTURE TO A KNOWN GROUND MOTION. ADMITTEDLY, THIS STILL IS FAR FROM PORTRAYING THE COMPLETE PICTURE AND MUCH MORE WORK REMAINS TO BE DONE IF TIME-DEPENDENT PHENOMENA SUCH AS THE DURATION OF SHAKING AND THE MATERIAL PROPERTY CHANGES THAT OCCUR DURING CYCLICAL LOADING ARE TO BE PREDICTED. WHETHER OR NOT WE WILL BE ABLE TO ACHIEVE THESE OBJECTIVES IS OPEN TO QUESTION, BUT WE ARE CERTAIN THAT SIGNIFICANT IMPROVEMENTS AND COMPLETELY NEW DEVELOPMENTS WILL CONTINUE TO BE MADE.

I SHOULD LIKE TO BRING TO YOUR ATTENTION A FEW RECENT SAMPLES OF HOW OUR RESEARCH IS DEVELOPING AN UNDERSTANDING OF EARTHQUAKES IN RELATION TO CONSTRUCTED FACILITIES AND IN REDUCING CASUALTIES, DAMAGE, AND SOCIAL AND ECONOMIC DISRUPTION AS A RESULT OF EARTHQUAKES.

UNTIL RECENTLY, THE DESIGN OF BUILDINGS TO RESIST EARTHQUAKE MOTIONS WAS BASED UPON THE ASSUMPTION OF EQUIVALENT HORIZONTAL STATIC FORCES ACTING ON A SINGLE FRAME SYSTEM, AND ON THE ELASTIC

BEHAVIOR OF THE MATERIALS, SUCH AS STEEL, REINFORCED CONCRETE AND MASONRY. TO IMPROVE THE BEHAVIOR OF BUILDINGS TO INCORPORATE GREATER SAFETY AND ECONOMY, RESEARCHERS HAVE DEVELOPED DYNAMIC TECHNIQUES THAT CONSIDER THE THREE-DIMENSIONAL ASPECTS OF THE BUILDING, THE INELASTIC BEHAVIOR OF THE CONSTRUCTION MATERIALS AND THE ACTUAL GROUND MOTIONS OF THE EARTHQUAKE. THE NEW ANALYTICAL METHODS HAVE RECENTLY BECOME AVAILABLE BECAUSE OF THE APPLICATION OF THE ELECTRONIC COMPUTERS AND THE DEVELOPMENT OF NEW CONCEPTS OF DETERMINING THE BUILDING RESPONSES TO THE EARTHQUAKE MOTIONS. THESE RECENT INNOVATIONS HAVE LED TO THE DEVELOPMENT OF NEW DESIGN PROVISIONS WHICH ARE CURRENTLY BEING INCORPORATED INTO LOCAL AND MODEL BUILDING CODES AND DESIGN PROCEDURES.

THESE NEW CONCEPTS WERE DEVELOPED BY RESEARCHERS AT CAL TECH, UNIVERSITY OF CALIFORNIA AT BERKELEY, AND THE UNIVERSITY OF ILLINOIS. VARIOUS GOVERNMENT AGENCIES, --- THE NRC, BUREAU OF RECLAMATION AND CORPS OF ENGINEERS, HAVE ALSO INCORPORATED THESE LATEST CONCEPTS INTO THEIR MISSION ACTIVITIES. THE ANALYTICAL CONCEPTS HAVE BEEN VERIFIED EXPERIMENTALLY FOR SOME APPLICATIONS BY RESEARCHERS AT BERKELEY, MICHIGAN, TEXAS AND ILLINOIS. AS A CONSEQUENCE, DESIGNERS AND BUILDING OFFICIALS HAVE BEEN EMPLOYING THESE NEW DESIGN TOOLS WITH GREATER CONFIDENCE IN ESTIMATING THE ULTIMATE SAFETY OF NEW AND REHABILITATED BUILDINGS.

BEFORE THE SEISMIC RESPONSE OF A STRUCTURE (I.E., BUILDING, DAM, BRIDGE, EMBANKMENT, ETC.) CAN BE CALCULATED, IT IS NECESSARY TO DETERMINE THE DYNAMIC LOADS THAT WILL BE APPLIED TO THE STRUCTURE AS A RESULT OF THE TIME AND LOCATION DEPENDENT GROUND MOTIONS generated by the earthquake.

An essential component of NSF-funded research is the study of earthquake records for the development and verification of ground motion models. NSF has funded the Seismic Engineering Branch (SEB) of the USGS to place and maintain ground motion instruments throughout the U. S., as well as in highly seismic areas outside of the U. S. The SEB maintains a library of these records, etc. The U. S. data is used throughout the world for aseismic design. The usefulness of such data is attested to by the many local, state and Federal agencies, which have recently initiated instrumentation programs.

NSF researchers are now developing procedures for predicting the detailed strong ground motion time-history generated by fault movement, based on known parameters of the fault. For example, K. Aki (MIT) has successfullly reproduced the Pacoima Dam record obtained during the 1971 San Fernando Earthquake, which contained the largest peak acceleration recorded up to that time. The soils overlying bedrock can either increase or decrease the amplitudes of the ground motions propagating to the structures. Researchers have developed analytical and numerical techniques to predict such effects, based on the physical and mechanical properties of the soils. These techniques are being utilized by virtually every engineering consulting firm and agency in the United States engaged in earthquake analysis related to construction. They are used in the seismic risk analysis of every nuclear power plant currently being designed in the United States, and for other critical structures such as dams, HOSPITALS, OFFSHORE PLATFORMS, AND LARGE CONSTRUCTION PROJECTS OF ALL KINDS.

IN 1978 NSF PROVIDED THE ASSOCIATION OF BAY AREA GOVERNMENTS (ABAG) A GRANT TO ORGANIZE AN INTERDISCIPLINARY TEAM COMPOSED OF REPRESENTATIVES FROM THE SOCIAL SCIENCES, LAW, ENGINEERING AND THE GEOSCIENCES TO STUDY THE LIABILITY OF GOVERNMENTS FOR EARTHQUAKE HAZARDS. THE SPECIFIC OBJECTIVES OF THE STUDY WERE TO: (1) DEVELOP KNOWLEDGE ON THE NATURE AND EXTENT OF LOCAL GOVERNMENT LIABILITY, (2) ADVISE GOVERNMENT ON HOW TO COPE WITH SUCH LIABILITY, AND (3) RECOMMEND WAYS THE LAW COULD BE CHANGED TO ENCOURAGE LOCAL AND STATE GOVERNMENTS TO REDUCE HAZARDS WITHOUT INCREASING THEIR LIABILITY. DATA WERE COLLECTED FROM SEVERAL SOURCES, INCLUDING INTERVIEWS WITH OFFICIALS AT SITES OF RECENT EARTHQUAKES IN ALASKA, WASHINGTON AND CALIFORNIA; AND FROM A QUESTIONNAIRE SURVEY IN 88 JURISDICTIONS IN UTAH, ALASKA, WASHINGTON AND CALIFORNIA. THE STUDY HAS RESULTED IN A SIGNIFICANT INCREASE IN KNOWLEDGE ON THE ROLE OF LAW AS AN INCENTIVE IN EARTHQUAKE HAZARDS REDUCTION.

THROUGH AN ANALYSIS OF THE LEGAL ASPECTS OF EARTHQUAKE PREDICTION, THE STUDY SHOWED THAT CALIFORNIA LAW WAS UNCLEAR REGARDING GOVERNMENT LIABILILTY FOR ACTIONS TAKEN IN CONNECTION WITH EARTHQUAKE PREDICTIONS AND THAT THIS WAS A POTENTIAL DISINCENTIVE TO OFFICIALS TAKING APPROPRIATE MEASURES, SUCH AS ISSUING PUBLIC WARNINGS FOLLOWING A SCIENTIFICALLY VALID PREDICTION. AS A RESULT OF THIS FINDING, ABAG'S STAFF WORKED WITH THE CALIFORNIA OFFICE OF EMERGENCY SERVICES AND THE CALIFORNIA SEISMIC SAFETY COMMISSION TO GET NEW LEGISLATION

INTRODUCED AND PASSED, SB 555, WHICH MAKES STATE OFFICIALS NOT LIABLE FOR ISSUING WARNINGS AND TAKING APPROPRIATE EMERGENCY ACTIONS FOLLOWING A STATE OF EMERGENCY DECLARATION.

FOR THE NATION, THESE AND OTHER ACTIVITIES OF OUR PROGRAM ARE RESEARCH INVESTMENTS THAT WILL BE FAR OVERSHADOWED BY SAVINGS TO BE REALIZED FROM THE PRACTICAL APPLICATIONS OF THIS RESEARCH.

THE PROGRAM WILL CONTINUE TO SUPPORT THE BASIC AND APPLIED RESEARCH REQUIRED TO INCREASE OUR ABILITY TO REDUCE THE LOSS OF LIFE AND PROPERTY DAMAGE DUE TO EARTHQUAKES. THIS NECESSARILY INVOLVES A MULTIDISCIPLINARY APPROACH AND AN EMPHASIS ON THE TRANSFER OF RESEARCH RESULTS AND IMPROVED ENGINEERING TECHNIQUES TO THE PUBLIC AND PRIVATE SECTORS. OVER THE NEXT FIVE YEARS, INCREASED EFFORT WILL BE PLACED ON INTERNATIONAL COOPERATIVE ACTIVITIES, SUCH AS THOSE PLANNED UNDER THE RECENTLY-SIGNED AGREEMENT WITH JAPAN. THESE EFFORTS WILL PROVIDE U. S. RESEARCH TEAMS WITH DETAILED DATA ON LARGE-SCALE TESTING OF STRUCTURES AND DATA OBTAINED FROM INSTRUMENTED AREAS SUBJECT TO FREQUENT SEISMIC RISK. IN ADDITION TO THE BILATERAL AGREEMENT WITH JAPAN, THE FOUNDATION AND THE U. S. GEOLOGICAL SURVEY HAVE SIGNED A PROTOCOL WITH THE PEOPLES REPUBLIC OF CHINA TO PURSUE COOPERATION IN THE FIELDS OF EARTHQUAKE ENGINEERING, PREDICTION, HAZARDS EVALUATION AND THE BASIC AND APPLIED STUDIES OF EARTHQUAKE PHENOMENA. ALSO, CONTINUED EMPHASIS WILL BE PLACED ON PROVIDING DETAILED ANALYTIC AND EMPIRICAL DATA THAT PROVIDE A TECHNICALLY SOUND BASIS FOR MITIGATION MEASURES SUCH AS THE MODIFICATION OF BUILDING CODES, DEVELOPMENT OF COST-EFFECTIVE LAND USE CONTROLS, AND IMPROVED CRITERIA FOR STRENGTHENING OR RECONSTRUCTING BUILDINGS AND OTHER

STRUCTURES THAT ARE SUBJECT TO EARTHQUAKE LOADINGS.

AS IN ALL FIELDS OF SCIENCE AND TECHNOLOGY, THERE ARE RESEARCHABLE PROBLEMS WHERE THE LIKELIHOOD OF SOLUTIONS RANGE FROM HIGH TO LOW. THOSE AREAS WHICH THE EARTHQUAKE HAZARDS MITIGATION PROGRAM IS ATTACKING WHICH WE BELIEVE HAVE A REASONABLE CHANCE OF SUCCESS INCLUDE:

- THE THREE-DIMENSIONAL CONSTITUTIVE RELATIONSHIPS FOR THE DYNAMICS OF SOILS UNDER EARTHQUAKE LOADING;

- THE ANALYSIS OF THE SEISMIC RESPONSE OF COMPLEX STRUCTURAL GEOMETRIES AND LARGE-SCALE STRUCTURES INVOLVING VERY LARGE NUMBERS OF DEGREES OF FREEDOM;

- QUANTITATIVE RELATIONSHIPS DESCRIBING STRUCTURE-SOIL INTERACTIONS WHICH ACCOUNT FOR THE COMPLEXITIES OF NATURAL SOIL MEDIA AND THE INCOHERENCE OF GROUND MOTION IN A SOIL CONTINUUM HAVING SPATIALLY HETEROGENEOUS PROPERTIES;

- THE ABILITY TO PREDICT THE GROUND MOTION TIME-HISTORY FOR A CERTAIN MAGNITUDE EARTHQUAKE IN A SPECIFIC AREA;

- METHODS OF DESIGN AND CONSTRUCTION TO ACHIEVE OPTIMUM ECONOMY FROM ALL STANDPOINTS INCLUDING MATERIALS, ENERGY, AND FUNCTIONALITY;

- THE ANALYSIS OF THE BENEFITS AND COSTS OF ALTERNATIVE MITIGATION AND PREPAREDNESS MEASURES; AND

O THE IDENTIFICATION OF SOCIAL, ECONOMIC AND LEGAL INCENTIVES TO AMELIORATE EXISTING HAZARDOUS CONDITIONS.

OUR PARTNERS IN IMPLEMENTATION OF THE EARTHQUAKE HAZARDS REDUCTION ACT - THE EARTH SCIENCES DIVISION OF THE FOUNDATION AND THE U. S. GEOLOGICAL SURVEY - ARE ACTIVELY INVOLVED IN BUILDING THE FUNDAMENTAL SCIENCE BASE THAT ADDRESSES THE PROBLEM OF PREDICTION AND CONTROL OF THE OCCURENCE, PERIODICITY AND MAGNITUDE OF SEISMIC EVENTS. THESE ARE VERY LONG TERM PROBLEMS AND RELIABLE METHODS OF PREDICTION AND CONTROL HAVE NOT BEEN DEVELOPED AND THEIR DEVELOPMENT WILL PROBABLY REQUIRE SEVERAL DECADES OF BASIC GEOPHYSICAL RESEARCH AND CONTINUED CLOSE COORDINATION.

OUR EXPERIENCE HAS SHOWN THAT A PROBLEM-FOCUSED RESEARCH ACTIVITY WITHOUT EFFECTIVE PARTICIPATION BY THE COMMUNITY THAT WILL UTILIZE THE RESULTS OF THE RESEARCH IS NOT LIKELY TO HAVE A SUBSANTIAL, POSITIVE IMPACT. AT ALL PHASES OF THE EARTHQUAKE HAZARDS PROGRAM REPRESENTATIVES OF STATE AND LOCAL GOVERNMENT, INDUSTRY AND THE DESIGN PROFESSIONS CONTINUE TO BE INVOLVED IN PLANNING, REVIEW AND EVALUATION OF THE CONTENT AND THE DIRECTION OF THE PROGRAM. WITHOUT THEIR ADVICE AND COUNSEL WE CAN NEVER HOPE TO SEE THE INCORPORATION OF OUR RESEARCH RESULTS IN A STATE AND LOCAL DISASTER PREPAREDNESS SYSTEM -- BUILDING CODES, ZONING RESTRICTIONS, DISASTER-RESPONSE PLANS -- THESE ARE THE END RESULTS FOR WHICH THE PROGRAM MUST PROVIDE THE SCIENTIFIC AND TECHNOLOGICAL BASE. THE FORMAL ARRANGEMENTS TO ENSURE PARTICIPATION ARE DEVELOPED IN TWO ADVISORY COMMITTEES: THE NSF ADVISORY COMMITTEE TO THE EARTHQUAKE HAZARDS MITIGATION PROGRAM, which is composed of university experts, members of the design professions, representatives of the California Seismic Safety Commission and a staff member from the national Academy of Sciences; and the Interagency Committee on Seismic Safety in Construction composed of representatives of all Federal agencies having significant involvements in construction, the financing of construction or closely related activities.

Two recent developments have significantly influenced the NSF program. The first was the September 1976 report to the President's Science Advisor on Earthquake Prediction and Hazard Mitigation Options for USGS and NSF Programs. That report provided the basis for establishing guideline budget levels for Federal research support at an unusually high level of specificity. Detailed budget recommendations were made for our program for the three year period, FY 1978 through FY 1980. The second major event was the passage of P.L. 95-124 on October 7, 1977 which assigned the Foundation a role as an active partner with specific responsibilities within a coordinated, Federal-wide research effort on earthquake hazards reduction.

That law, the Earthquake Hazards Reduction Act of 1977, authorized appropriations for NSF not to exceed $102,500,000 for the same three year period covered by the 1976 report, FY 78-80. During this time NSF requested funds for these purposes in the amount of $66,200,000. In response to this request the Congress appropriated approximately $52,500,000 which has been obligated in support of the program. The basis for the NSF request was provided by Option B (i.e., the intermediate option) of the

September 1976 report, commonly referred to as the "Newmark Report." Option B, which recommended a total $79,200,000 for the program during the three year period, was selected by the Executive Office as the budgetary and programmatic guideline. I have prepared an analysis of our program activities which describes the progress made in implementing the Act and the accomplishments of our program. I should like to submit this analysis for the record.

In my view, we have made significant progress in research in the social sciences which addresses the crucial problems of understanding how people and communities respond to earthquake disasters and ways in which measures of preparedness can be developed to mitigate these certain but as yet unpredictable disruptions.

Thank you Mr. Chairman for allowing me the opportunity to share with you my enthusiasm for this program. We feel we have developed a broad based scientific program and look forward to moving ahead vigorously in meeting the objectives of the Earthquake Hazards Reduction Act.

I shall be happy to answer any questions you or members of this subcommittee may have.

## APPENDIX A - SUMMARY OF PROGRESS

### A. FUNDING HISTORY

At the request of the President's Science Advisor, a report on Earthquake Prediction and Hazard Mitigation Options for USGS and NSF Programs was prepared by an external advisory group and submitted in September 1976. This report, commonly referred to as the Newmark Report, presented three funding options; A, B and C, to guide the implementation of the NSF research program in this area during the three year period ending with FY 1980. Option B was subsequently selected by the Executive Office as the budgetary and programmatic guideline through FY 1980. This option specified annual funding levels for the principal elements of Engineering and Research for Utilization(Societal Response). In addition, major divisions of these elements were made into tasks, schedules of action and support levels for these separate tasks. One year later, with the passage of the Earthquake Hazards Reduction Act of 1977 (P.L. 95-124), Congress authorized appropriations for these purposes not to exceed designated annual levels. These and other relevant budget figures for the period 1976-80 are presented in Table 1.

During the three year period, FY 1978 through FY 1980, Congress provided $52.5 million, 80% of the amount requested by NSF for the program, to carry out the responsibilities assigned to NSF under P.L. 95-124. While the Act carried an authorization not to exceed $102.5 million for these purposes over this period, NSF has generally followed Option B of the Newmark Report as a guideline for its annual request.

What have been the areas of NSF responsibility within the Act? Section 5(e) of the Act designates nine research elements, listed in Table 2, in the National Earthquake Hazards Reduction Program. These were incorporated into the Implementation Plan subsequently developed according to instructions in Section 5(f). In the Implementation Plan, NSF was assigned responsibility to:

> "Support fundamental research studies on earthquakes, and basic and applied research on earthquake engineering and policy."

This assignment for the EHM Program has been interpreted to respond strongly to elements (5), (6), (7) and (8) while more limited involvements engage (3) and (9). NSF's Geophysics Program is conducting a research effort in element (1) while the USGS generally has assumed the principal role in elements (2), (3) and (4).

## TABLE 1

## FUNDING LEVELS

| | | | $ millions | | |
|---|---|---|---|---|---|
| | FY 76 | FY 77 | FY 78 | FY 79 | FY 80 |
| EHR Act of 1977 | | | 27.5 | 35.0 | 40.0 |
| Newmark Report (Option B) | | | | | |
| Engineering | | | 15.6 | 20.3 | 25.0 |
| Societal Response | | | 4.9 | 6.1 | 7.3 |
| | | | 20.5 | 26.4 | 32.3 |
| NSF Request to Congress | | | | | |
| Engineering | 7.15 | 6.8 | 15.0 | 21.6 | 17.3 |
| Societal Response | 0.80 | 1.4 | 6.5 | 4.8 | 1.0 |
| | 7.95 | 8.2 | 21.5 | 26.4 | 18.3 |
| NSF Obligation* | | | | | |
| Engineering | 7.15 | 7.54 | 15.29 | 16.14 | 16.9 |
| Societal Response | 1.19 | 1.73 | 2.40 | 0.8 | 1.0 |
| | 8.34 | 9.27 | 17,69 | 16.94 | 17.9 |

*Note: During the Transition Quarter 1976 NSF Obligations were:
Engr. $2.99 million; Soc. Resp. $0.26 million

### TABLE 2

### Earthquake Hazards Reduction Act of 1977
(PL 95-124)
Section 5(e) Research Elements

RESEARCH ELEMENTS. The research elements of the program shall include:

(1) research into the basic causes and mechanisms of earthquakes;

(2) development of methods to predict the time, place, and magnitude of future earthquakes;

(3) development of an understanding of the circumstances in which earthquakes might be artifically induced by the injection of fluids in deep wells, by the impoundment of reservoirs, or by other means;

(4) evaluation of methods that may lead to the development of a capability to modify or control earthquakes in certain regions;

(5) development of information and guidelines for zoning land in light of seismic risk in all parts of the United States and preparation of seismic risk analyses useful for emergency planning and community preparedness;

(6) development of techniques for the delineation and evaluation of the political effects of earthquakes, and their application on a regional basis;

(7) development of methods for planning, design, construction, rehabilitation, and utilization of manmade works so as to effectively resist the hazards imposed by earthquakes;

(8) exploration of possible social and economic adjustments that could be made to reduce earthquake vulnerability and to exploit effectively existing and developing earthquake mitigation techniques; and

(9) studies of foreign experience with all aspects of earthquakes.

Note: political should read potential. This is a final typesetting error which is common knowledge but remains unchanged in the Act.

With respect to the specific assignments in the Implementation Plan, NSF has provided $48.3 million for earthquake engineering research and $4.2 million for policy (Societal Response) studies, 90% and 34% respectively, of the requests made to Congress for these activities.

For this program, the principal impact of the Act has been to double the previous earthquake engineering research effort in the United States. It is concluded that Congress has generally supported the NSF role in earthquake engineering research at an appropriate level while the social science element of the program has not been as well received. Furthermore, it is clear that the program has responded to the intentions of the Act wherever it has been mandated to do so and has participated actively in the Implementation Plan formulated in accordance with Section 5(f) of the Act. Funds in the limit of those authorized by the Act have not been requested since the Executive Office recommendation favored a spending profile of approximately 77 percent of the limit authorized over the three year period, FY 1978-80. A detailed analysis of the NSF response to the Newmark Report is given in the following section.

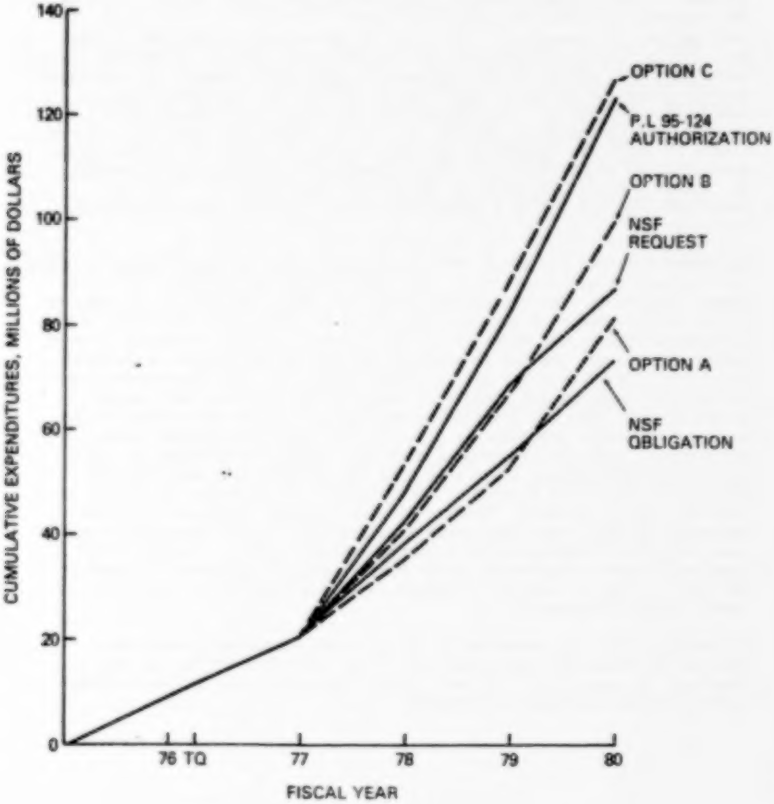
## B. COMPARISON WITH THE NEWMARK REPORT

The Newmark Report projected three funding options for the period FY 1978 through FY 1980. These budgets, those authorized under the Act, and the NSF response are shown as cumulative trends in Figure 1. It is seen that Option C is essentially the limit of those funds authorized by the Act. NSF's request to Congress, with exception of the FY 80 request, is coincident with Option B, the recommended guideline. However Congressional appropriations to NSF have permitted obligations at the lower rate specified by Option A. With respect to the issue of the decreased FY 1980 request, the Foundation's request in FY 1979 to Congress was $26.4 million (Table 2) which was reduced by $9.0 million by Congressional action to an appropriation of $17,400,000. The following year it was judged prudent to request a modest increase to $18,300,000 thus creating the first departure from the Option B guideline in seeking funds from Congress for the program.

The Newmark Report contained detailed program area and budget specifications for Engineering and Research for Utilization-Societal Response which are shown in Table 3. The NSF response over the three year period is compared to the Newmark Option B guideline in Figure 2. The major departure is the difference between the Research for Utilization(Societal Response) element budget request and the net to program from the appropriation, a decrease of $8.1 million from $12.3 million to $4.2 million. The Engineering subelement (d) Response and Structures received considerably more emphasis by the program than was provided by the Newmark Report guidelines on the basis of arguments presented by a much larger than anticipated number of meritorious, high-quality proposals on this topic. Subelement (c) Soil Properties and Failure is an area that has historically been slow to develop because of an absence of constitutive relationships for soil, rock and composite media, theoretical underpinnings which are just now beginning to reach the stage where experimental research can play a major role in further development of a strong research effort. In most other subelement areas highlighted by the Newmark Report the level of support NSF has provided is generally comparable to the cumulative fractional levels given in Option B.

In summary, with the exception of the Societal Response element the program has respected the guidelines of the Executive Office and the Congress, in exercise of its legislated responsibilities in the National Earthquake Hazards Reduction Program.

FIGURE 1 CUMULATIVE EXPENDITURE LEVELS FOR THE NSF EARTHQUAKE HAZARDS MITIGATION RESEARCH PROGRAM



## Table 3

## Guidelines for Engineering and Research for Utilization Elements

Present and Proposed Funding Options
Element: 5. Engineering

| Sub-Element | FY 76 | FY 77 | Fiscal Year 1978 | | | Fiscal Year 1979 | | | Fiscal Year 1980 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Act. | Req. | A | B | C | A | B | C | A | B | C |
| a. Ground Motion Characterization | 0.7 | 0.7 | 1.0 | 1.4 | 2.1 | 1.3 | 2.3 | 2.5 | 2.0 | 2.4 | 2.6 |
| b. Strong-Motion Data Acquisition | 0.9 | 0.9 | 2.0 | 2.6 | 3.6 | 2.2 | 3.0 | 3.8 | 3.1 | 3.3 | 4.0 |
| c. Soil Properties and Failure | 1.6 | 1.5 | 1.6 | 2.3 | 4.8 | 1.7 | 3.8 | 5.5 | 4.9 | 5.2 | 6.1 |
| d. Response and Structures | 2.6 | 2.6 | 3.7 | 5.7 | 9.0 | 3.9 | 6.6 | 9.4 | 7.2 | 8.1 | 9.8 |
| e. Special Structures and Systems | 1.2 | 0.9 | 2.1 | 3.3 | 6.1 | 2.3 | 4.2 | 6.3 | 5.0 | 5.6 | 7.0 |
| f. Post Earthquake Investigations | 0.1 | 0.1 | 0.2 | 0.3 | 0.4 | 0.3 | 0.4 | 0.5 | 0.3 | 0.4 | 0.5 |
| TOTAL | 7.1 | 6.7 | 10.5 | 15.6 | 26.0 | 11.6 | 20.3 | 28.0 | 22.5 | 25.0 | 30.0 |

(Amounts are in Millions of Dollars)

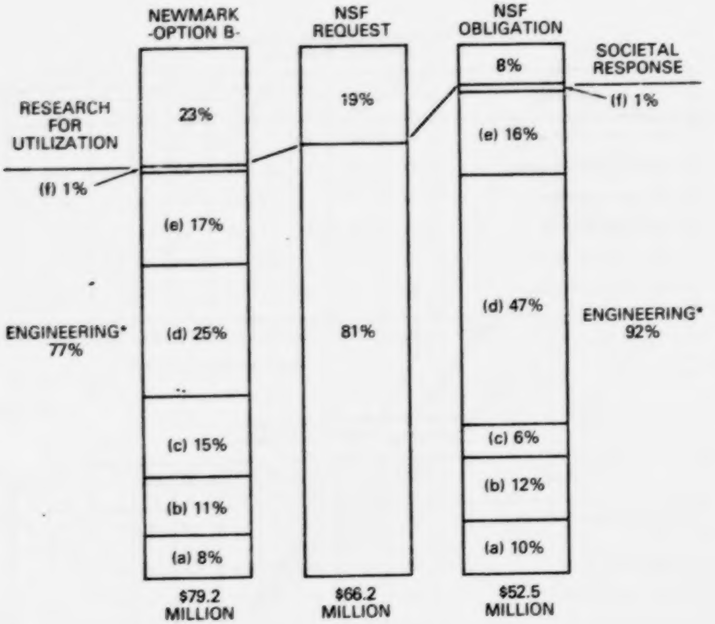
Present and Proposed Funding Options
Element: 6. Research for Utilization

| Sub-Element | FY 76 | FY 77 | Fiscal Year 1978 | | | Fiscal Year 1979 | | | Fiscal Year 1980 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Act. | Req. | A | B | C | A | B | C | A | B | C |
| a. Earthquake Mitigation Resources Allocation | 0.0 | 0.0 | 0.8 | 0.8 | 1.1 | 1.0 | 1.0 | 1.5 | 1.4 | 1.5 | 1.9 |
| b. Preparedness | 0.0 | 0.0 | 0.8 | 0.8 | 1.2 | 1.2 | 1.2 | 1.2 | 0.8 | 1.2 | 1.2 |
| c. Relief and Rehabilitation | 0.0 | 0.0 | 0.0 | 0.0 | 0.8 | 0.0 | 0.8 | 0.8 | 0.8 | 1.0 | 1.2 |
| d. Information Flow | 0.0 | 0.0 | 2.4 | 2.4 | 2.4 | 2.2 | 2.2 | 2.2 | 2.0 | 2.0 | 2.0 |
| e. Regulation and Assessment | 0.0 | 0.0 | 0.0 | 0.9 | 1.0 | 0.9 | 0.9 | 1.6 | 1.6 | 1.6 | 1.6 |
| TOTAL | 0.0 | 0.0 | 4.0 | 4.9 | 6.5 | 5.3 | 6.1 | 7.3 | 6.6 | 7.3 | 8.0 |

(Amounts are in Millions of Dollars)

From: The President's report on "Earthquake Prediction and Hazard Mitigation Options for USGS and NSF Programs" p. 54 & p. 65.

FIGURE 2 DISTRIBUTION OF FUNDS REFERENCED BY ELEMENT AND SUBELEMENT IN THE NEWMARK REPORT (TABLE 3)



*REFER TO TABLE 3 FOR SUBELEMENT DESCRIPTIONS.

## C. TRENDS IN RESEARCH - COHERENT EFFORTS

### Engineering

Although titled, "Engineering," the research carried out in this element of the NSF program has focused on architectural and urban planning problems as well as those of either a structural or geotechnical engineering nature. Research is providing new information on the nature and effects of destructive ground shaking and improved methods of analysis, planning and design for safe and economic earthquake countermeasures. Many disciplines are involved in the effort and contributions from economics and systems analysis, for example, are as important as those from the more closely allied fields mentioned previously.

In spite of the fact that destruction due to earthquakes has plagued civilizations for thousands of years, it is only in relatively recent times that the problem of constructing facilities to resist the effects of earthquakes has been approached in a scientific way. Some interest was generated after the 1906 San Francisco earthquake, but it was not until after the 1933 Long Beach earthquake that a building code was revised to require a rudimentary earthquake resistant design.

During these early years, little was known about the ground motions realized in an earthquake and attempts were initiated to make measurements of the actual ground motion which occurs. The ability to process any strong motion records obtained or to calculate the dynamic response of structures as a result of such strong ground motion was severely limited due to a lack of fundamental methods of analysis and high speed computational equipment capable of processing large volumes of information. Sporadic progress was made using crude shaking tables and simplified structural models and, in the late 1940's to the early 1950's, using analog computers.

The state-of-the-art for earthquake design which evolved during this period depended on the use of a strictly static approach to a dynamics problem. In such an approach equivalent lateral static loads are applied to a structure by use of a force coefficient to hopefully account for earthquake loads which may subsequently occur during the service life of the structure. Taken in its simplest form, such an approach takes no account of the frequency content, duration or amplification effects in the incoming strong-ground motion loadings, the potential interaction between a structure and its supporting soil, the linear and nonlinear frequency responses of the structure and the associated secondary systems or the ductility requirements needed to resist dynamic earthquake loadings. The deficiencies of such an approach have been graphically illustrated by the total collapse of the Four Seasons apartment building in Anchorage during the 1964 Alaska earthquake and other similar structures. This new reinforced concrete structure, which was constructed according to the then existing (static approach) code, had just been completed but fortunately was not yet occupied. Since that time, constant progress has been made through research in improving our ability to cope with earthquakes.

Damage to man-made structures during an earthquake occurs because the energy from the earthquake source is transmitted through geologic media in the form of various types of waves. These waves include both body (e.g., dilatational, shear waves) and surface waves (e.g., Rayleigh, Love waves). The amplitude, frequency content and duration of the waves at a specific site constitute the dynamic loading acting on structures. The capability to predict the characteristics of such waves generated by an earthquake has lagged because of a lack of adequate correlated field information recorded during actual earthquakes and a lack of adequate analytical methods, thereby presenting a barrier to the prediction of structural damage.

Research has resulted in advancements in several areas of soil/rock dynamics. Analytical techniques have been developed to describe the ground motion time-history of source mechanisms as a function of fault parameters. While still in the investigative stages, such models now provide a basis for placing bounds on the ground motions for well-defined fault zones, and also provide a means for parametric studies of such phenomena. Through analytical and empirical studies of ground motion records, it is now possible to estimate the attenuation of wave energy and reduction in amplitudes as a function of the regional geology. Computer codes and analytical models are available to compute the dynamic response of soils/rocks at specific sites. Thus, tools are now available for determining the expected ground motions at a specific site of interest, which was once considered an intractable problem. The major deficiencies in the use of such tools are a lack of accurate constitutive relations for soils and rocks and a lack of case history studies to verify and improve the analytical models.

In addition to linear and nonlinear dynamic response of geologic materials, it is necessary to determine permanent deformations (e.g., settlement), stability (e.g., slopes), failure criteria and soil-structure interaction effects. New laboratory testing methods to evaluate the constitutive relations have been evolving, which provide elastic parameters, stress-strain relationships, and failure criteria. A particularly significant advancement resulting from laboratory testing has been the engineering solution to the progressive failure of saturated granular soils under cyclic loading (i.e., liquefaction). These laboratory tests have been related to liquefaction of large soil masses during earthquakes, and it is now possible to evaluate the potential for liquefaction in the field.

A recent workshop of experts in geotechnical engineering has defined the future research needs for earthquake engineering applications. These needs are separated into four major areas: (1) to improve our understanding of basic fundamentals, (2) to improve design methods, (3) to evaluate and verify the design procedures, and (4) to transfer technology.

A methodology to compute the peak response of a linearly elastic structure to a given ground motion time history, i.e., the "response spectrum" method, has been developed in recent years. This quasi-dynamic analysis was a major step forward in understanding and predicting the behavior of structures. By studying the ground motion records for past earthquakes, "bounds" for the response spectra have been obtained, resulting in "smoothed" response spectra useful for design purposes. Empirical modifications have been made to the response-spectrum quasi-dynamic method in an attempt to deal with the inelastic and nonlinear behavior which will exist in real structures subjected to strong earthquake motion. On a practical level, this approximate response spectrum technique is the main tool available to designers until improved methods are developed through research.

Advances in computer technology and numerical analyses (finite elements, finite differences, etc.) have permitted researchers to start to develop techniques to compute the response of structures as a function of time for a given earthquake shaking and as a function of the assumed mechanical properties of the structure. With such procedures one would not be restricted to linear elastic structures, and procedures are now being developed by researchers to determine the response of structures after the material has been stressed beyond its elastic limit, i.e., inelastic response analysis. Computer technology also permits research into the 3-dimensional behavior of structures.

A necessary activity of theoretical development is the verification of the basic assumptions used to develop the theory. Advances in experimental methods and techniques have accompanied the theoretical developments. The previously used method of unidirectional monotonic loading equipment has been replaced by activators which can apply cyclic loadings to structural components and building systems, to provide quasi-seismic forces representing earthquake motions. These techniques have provided experimenters with a method of determining the response of structures and materials in such a manner that the cyclic effect can be studied in detail to confirm and/or revise the theoretical concepts.

One of the major objectives of earthquake engineering is to predict the response of structures subjected to severe earthquake excitation. While effort has been devoted to developing computer programs for performing such analyses, it has also become apparent that much more detailed information on the actual damage performance of such components is needed to validate the programs before reliable computer predictions can be made. A principal experimental facility which has been developed for study of complete structures is the Earthquake Simulator Facility (i.e., shaking table) at the University of California's Richmond Field Station which first began its pilot runs in 1972 and has been in full operation since March 1973.

Although a shaking table can provide exceedingly valuable information, its capabilities are limited by the size of the test structure which can be dealt with, the cost of the facility and its operation and the difficulty of simulating soil-structure interaction. Recent attention has been directed toward a variety of alternative approaches such as the use of less expensive strong-back or reaction wall facilities which can handle full-size structures with real-amplitude but not real-time cyclic motion, tests using artificially generated ground motions and observation and measurements on actual structures. Field studies will be of particular importance in studying the earthquake risk present in existing structures, developing methods to evaluate this risk and in studying ways to modify existing structures to increase their seismic resistance to acceptable levels. A particular concern is on reinforced masonry structures which have not received much study in the past.

The actual regulation of construction practices for buildings is generally effected through design codes and standards. Thus, there is a need to provide a mechanism to transfer research results into a form which can influence construction practices. This need resulted in support of the Applied Technology Council (the research organization of the Structural Engineers Association of California) to provide seismic design provisions which can serve as a basis for model and local code revisions. A model document (ATC-3) has been prepared combining improved seismic design provisions and is presently being evaluated by several professional engineering groups.

## Societal Response

Research supported through the Societal Response element covers a range of topics. These toipcs have tended to fall into three substantive or coherent areas: the socioeconomic aspects of mitigation and preparedness, hazard information dissemination and warning, and disaster impacts and responses.

### Socioeconomic Aspects of Mitigation and Preparedness

Several investigations have been conducted, or are still underway, addressing such matters as the social, economic, political and legal factors that encourage or discourage hazard mitigation and preparedness. For example, since decision-makers need to know the public's attitude towards mitigation and preparedness and its willingness to support such efforts, NSF has funded research on these topics, including a major study by sociologists at the University of Massachusetts. NSF has also funded studies focusing on specific mitigation and preparedness strategies, such as seismic safety regulations and hazard insurance. For example, NSF is supporting a current study by political scientists at the University of

California, Santa Barbara, on seismic safety preparedness of local governments in 14 jurisdictions in California. This study includes an analysis of the impact of legislation requiring cities and counties to develop a seismic safety element or plan as part of their general planning. A related study has examined the impact of local government liability on earthquake hazards mitigation.

### Hazard Information Dissemination and Warning

The research on hazard information dissemination and warning is intended to provide a sound scientific basis for improving existing dissemination programs and procedures and for creating new ones. Because seismologists and geologists are working toward developing the capacity for reliable earthquake prediction, NSF has supported a group of social science studies aimed at producing knowledge that will increase the benefits of the emerging technology and minimize its social costs. Studies with implications for policies related to earthquake prediction and warning have been carried out with NSF funding at such institutions as the National Academy of Sciences, the University of Colorado and the University of California, Los Angeles. For example, a study at the latter institution under the direction of sociologist, Ralph Turner, is assessing public response to the southern California Uplift, which some scientists thought could be an earthquake precursor, in order to identify some of the social problems that can be anticipated following future earthquake predictions and warnings.

NSF has also supported studies on the social response to warnings of other hazards, such as hurricanes, tornados and floods. In addition to measuring the effectiveness of warning systems for these particular types of hazards, such studies also have important implications for the design of future earthquake warning strategies.

While much of the activity funded under the Societal Response element has been strictly research, education and dissemination efforts are also supported. Many conferences, workshops and specialized publications have been supported that are aimed at such audiences as researchers, public interest groups, and local, state and Federal officials. The Natural Hazards Research and Applications Information Center at the University of Colorado is an example of NSF's long-term commitment to educating local, state and Federal emergency management officials and others about relevant research results in the hazards field. Public interest groups like the Council of State Governments have also been supported because of their capacity to interpret research findings on hazards for the groups they represent. NSF recently initiated interagency agreements with other Federal agencies, including FEMA, to joint fund two major dissemination projects. One of these agreements involves providing continuing support for the Natural Hazards Research and Applications Information Center.

## Disaster Impacts and Responses

NSF has funded recent studies on the short- and long-term impacts of disasters on communities in the United States, as well as studies on the impact of earthquakes in other societies which provide new perspectives for understanding our own experiences with these hazards. For example, Frederick Bates, of the Univeristy of Georgia, is investigating the socio-economic consequences of the 1976 Guatemala earthquake and the responses of relief organizations, including those from the United States. Various aspects of disaster relief, rehabilitation and recovery following disasters in the United States are being investigated by social scientists, including researchers at Ohio State University's Disaster Research Center, with support from NSF. The purpose of such research is to produce the requisite knowledge for developing institutional measures that will speed the recovery of communities struck by earthquakes and other disaster agents.

## D. 5-YEAR PLAN

### Engineering Element

The goal of the earthquake hazards mitigation program of NSF is to develop an understanding of earthquakes in relation to constructed facilities and to reduce casualties, damage and social and economic disruption as a result of earthquakes. The actions necessary to atain these goals are heavily dependent upon technical capabilities which require development through research. Primary objectives of this research during the next 5 years are:

- To determine, from instrumental data, the nature of strong ground shaking during earthquakes, to develop analytical procedures to predict the spatial and temporal distribution of strong ground motion at different sites and to understand the dynamic behavior of soil and rock subjected to strong shaking;
- To determine the nature of the interaction of structures and the supporting soil during earthquakes and the engineering aspects of reservoir induced seimicity;
- To develop procedures for performing dynamic analyses of proposed or existing construction under earthquake loadings, to develop an understanding of materials and structural components subjected to damaging dynamic loads and to develop procedures for analysis and design of non-structural and architectural systems for earthquakes effects; and,
- To study the influences of architecture and urban planning activities on earthquake vulnerability of regions.

chievement of these objectives will involve a long-term effort by repre-
nting a variety of disciplines. Because the program spans such a variety
activity, ranging from basic research needed to develop an understanding
phenomena to the development of design methods and information which may
timately be adopted by designers, there is a special need to provide

mechanisms to facilitate the flow of information and data from the originators to the users of information. To facilitate this information transfer, coordination is maintained with other Government agencies such as NRC, DOT, NBS, HUD, VA, Corps of Engineers, etc. Special attention is given to this problem in the NSF Earthquake Hazards Mitigation Program.

The general objectives of the program are divided into fifteen somewhat more detailed objectives based on reasonably coherent groupings of technical activities. Lengthy descriptions would be required to explain the scope of each of the fifteen objectives, however, a list of descriptive titles will provide an indication of the broad scope of activities involved in a coherent earthquake engineering, architecture and urban planning program. These objectives are:

1. To gain an understanding of the nature and distribution of destructive earthquake ground motions;

2. To develop and install instrumentation to measure strong earthquake ground motions and their effect on constructed facilities;

3. To develop through experimental and analytical research an understanding of the behavior of geotechnical materials subjected to destructive earthquake loadings;

4. To develop analytical, numerical and computer methods to study and predict dynamic response of structural systems;

5. To experimentally determine the structural properties of materials, elements and systems subjected to intense cyclic dynamic loadings up to the failure point;

6. To develop methods to evaluate the hazard potential of existing buildings and structural systems;

7. To develop methods of analysis and design to reduce damage to non-structural and architectural systems subjected to damaging dynamic loads;

8. To develop methods to reduce earthquake vulnerability of buildings and urban regions through improved architectural and urban planning analysis;

9. To develop improved methods to predict destructive seismic effects on coastal and inland waterways;

10. To develop methods to predict seismic effects on distributed lifeline facilities;

11. To continue and improve procedures for rapid response to optimize learning from post-disaster earthquake studies;

12. To develop international cooperative research programs which take advantage of unique research opportunities;

13. To improve existing and develop new information transfer programs to speed the flow of information developed through research to operational government agencies and to design professionals;

14. To develop improved methods to assess and predict the safety of dam-reservoir systems, and

15. To study the interaction between design considerations for other hazards and seismic resistance of constructed facilities.

Research activities up to the present have primarily concentrated in categories 1 thru 7 and 12 and 13. Efforts will be made to stimulate high-quality record activities in the future which cover the full-range of needs for a knowledge-base in these areas. Among the items which deserve special attention are the reduction of damage potential in light-frame buildings such as residential construction and the reduction of losses due to damage to architectural components and secondary systems in buildings and to building contents.

## Societal Response Element

Research in this area focuses on the social, economic, legal and political factors related to the adoption of adjustments to earthquake hazards. The main purpose of this research, which complements the engineering and geophysical research conducted under the other element of the Earthquake Hazards Reduction Program, is to develop and evaluate measures which individuals, private groups and government can use to mitigate and respond to earthquake impacts. These measures include emergency preparedness, land use planning, building codes, insurance, and information and education. Additionally, this research attempts to develop knowledge to improve earthquake prediction and warning, relief and rehabilitation, and long-term recovery. It is important that all of these measures and processes receive thorough attention from researchers so that a proper balance among social adjustments to earthquake can be achieved in threatened areas of society.

Modifications in building codes and land-use regulations and the issuance of earthquake predictions and warnings can have major social, economic, legal and political consequences. Whether such measures have a positive effect on mitigating hazards, or are overlooked altogether, may depend on the method in which the public or decision-makers are informed about them. Also the adoption or nonadoption of disaster response plans by government and private entities, as well as the utilization of earthquake insurance, can be attributed to socioeconomic factors which as yet are not fully understood.

## Objectives

The major objectives of the Societal Response element are to:

1. Develop knowledge on the socioeconomic aspects of hazards mitigation.
2. Increase the base of knowledge on preparedness for earthquakes and other hazards.
3. Improve the understanding of disaster impacts and responses.
4. Provide a basis for improving the dissemination of information on earthquake hazards and its utilization by decision-makers and the public.

## APPENDIX B - ACCOMPLISHMENTS

The primary objective of the NSF Earthquake Hazards Mitigation (EHM) Program is to support basic and applied research on earthquake engineering and policy ("The National Earthquake Hazards Reduction Program," page 26). NSF has supported research in all of the areas specified by the 1977 Earthquake Hazards Reduction Act that are within NSF's charter. In addition, NSF has consistently required that research results be presented in a lucid manner and widely disseminated to the potential users. Several areas specified in the Earthquake Hazards Reduction Act where NSF research has made significant progress in recent years are summarized below. These areas are separated into several coherent topics: (A) Earthquake-Resistant Design, (B) Model Codes, (C) Societal Response, (D) Programs with Other Countries, and (E) Learning from Earthquakes.

## A. EARTHQUAKE-RESISTANT DESIGN

### (1) Zoning and Planning

Efforts to reduce property damage from earthquakes by controlling the type of building construction through zoning ordinances are just beginning to be considered. Whether or not zoning restrictions will work will depend on how well correlations between local geologic conditions, and the frequency, amplitude and duration of ground motion can be made.

Past efforts at zoning have generally worked with zones covering relatively large areas such as a major portion of a state or at least a large number of counties. Investigations after actual earthquakes have shown that there are very large variations in the intensity of ground motion and resulting damage over relatively small distances. This indicates the need for a process of microzonation in which zones covering local areas on the order of city block size might be established with proper consideration for economic impacts as well as physical response.

Recognizing a need for a multi-disciplinary interaction on the microzonation problem, NSF organized a first conference on the subject in 1972. This has been followed up in 1978 by the NSF-supported Second International Conference on Microzonation for Safer Construction -- Research Application. Both of these conferences brought together an interdisciplinary group to interact on the problems of microzonation. The first conference produced a two-volume proceedings and the second produced a three-volume proceedings. These proceedings provide a significant resource of integrated information on the subject and provide a principal information source to persons concerned with the microzonation problem.

## (2) Seismic Loading on Structures

Before the seismic response of a structure (i.e., building, dam , bridge, slope, etc.) can be calculated, it is necessary to determine the dynamic loads that will be applied to the structure as a result of the vibratory ground motions generated by the earthquake.

Until a decade ago, the design of structures to resist earthquakes incorporated an additional horizontal static force to account for seismic loading. This static force was usually a percentage of the weight of the structure being designed, e.g., 10%. It was soon realized as numerous failures were encountered that such a "static" analysis was inadequate in providing safe structures in seismic areas.

NSF-funded research by Dr. G.W. Housner and his colleagues at the California Institute of Technology in the 1960's resulted in a methodology to compute the peak response of a linearly elastic structure to a given ground motion time history, i.e., the "response spectrum" method.

This quasi-dynamic analysis was major step forward in understanding and predicting the behavior of structures. This powerful analytical tool became the subject of intense research both in the public and private sectors. Improved procedures were developed by researchers at Cal Tech, the University of California, Berkeley, and by Dr. Nathan Newmark and his associates at the University of Illinois. The research cited above has been incorporated by the Nuclear Regulatory Commission (NRC) into the design of nuclear power plants, and by the Corps of Engineers and the Bureau of Reclamation for the design of dams, and by model codes and local regulatory agencies for the design of buildings.

Recent concern for the safety of critical facilities has dictated more accurate analyses procedures, which necessitates the prediction of the time-history of earthquake-generated ground motions. Such predictions require consideration of the earthquake source characteristics, the diverse nature of the transmission path for the radiated energy and the local site conditions. While extremely complex in nature, researchers have systematically addressed various aspects of the problem and it is anticipated that accurate predictions of dynamic loads as a function of time (i.e., time-histories) will be possible in the next few years. The solution of the problem requires research into fault fracturing mechanisms, wave propagation through heterogeneous materials, energy attenuation by geologic media, effect of various soils on modifying ground motions at the site of interest, and the interaction effects of soils and rocks with the structure being studied. Progress in these areas has been substantial in the last several years.

An essential component of this research is the study of earthquake records for the development and verification of ground motion models. NSF has funded the Seismic Engineering Branch (SEB) of the USGS to place and maintain ground motion instruments throughout the U.S., as well as in highly seismic areas outside of the U.S. The SEB also maintains a library of these records, interprets and disseminates the data to designers, researchers, etc. This U.S. data is used throughout the world for aseismic design. The usefulness of such data is attested to by the many local, state and Federal agencies, who have recently initiated instrumentation programs for various types of structures.

Our knowledge of the forces generated during earthquakes has undergone a radical change as evidenced by the inability to correlate the Richter Magnitude of the earthquake with the peak ground acceleration. (Such a relationship was assumed in earlier seismic engineering design.) Recent observations show that small earthquakes can yield very high accelerations (e.g., .69g from a Richter 3.5 earthquake) and that sets of data at a common site show substantially different characteristics in different events.

NSF researchers are now developing procedures for predicting the strong ground motion time-history generated by fault movement, based on known parameters of the fault. This research is being conducted at MIT, UCLA, Stanford, Berkeley, USC, and several other universities. For example, K. Aki (MIT) has successfully reproduced the Pacoima Dam record obtained during the 1971 San Fernando Earthquake. This time-history contained the largest peak acceleration recorded up to that time.

The soils overlying bedrock can either increase or decrease the amplitudes of the ground motions propagating to the structures. Researchers have developed analytical and numerical techniques to predict such effects, based on the physical and mechanical properties of the soils. These techniques are being utilized extensively in the design of structures in seismic areas. Further refinements of soil models are being developed, which will increase the capability in predicting structural response.

Several computer programs, developed by Professor H. Bolton Seed and John Lysmer at the University of California, Berkeley, provide the capability to study soil responses to earthquakes in order to provide a more realistic basis for the design of buildings, dams, nuclear plants, offshore platforms, bridges, and other structures to withstand earthquakes. In the short time the programs have been available, millions of dollars have been spent in computer time for their use and billions have been spent on the major construction projects to which they have been applied. These computer programs represent the state-of-the-art in the prediction of soil response to earthquakes. These rograms are used by virtually every engineering consulting firm in the nited States engaged in earthquake analysis related to construction. hey are used in the seismic risk analysis of virtually every nuclear ower plant currently being designed in the United States, and in stablishing design criteria for dams, hospitals, offshore platforms, nd large construction projects of all kinds.

The analytic capabilities of the SHAKE program have been adopted by the Structural Engineers Association of California (SEAOC) and will soon become incorporated in the Uniform Building Code of the International Conference of Building Officials. The American Association of State Highway Transportation Officials (AASHTO) has recently incorporated standard tables and curves based on SHAKE into its design criterion codes for bridges. The California State Highway Department also has used this program to evaluate stability of embankments to earthquake loading.

### (3) Design

The design process requires an analysis to predict the seismic resistance of the structure under consideration and to select the structural material and construction details to ensure the predicted safety. Theoretical analysis methods must be developed which will predict the seismic resistance of a building which takes many forms, may be of varying heights and of different materials.

The economics of design and construction of buildings and bridges dictates that the behavior of the building must be such that it will absorb and dissipate the energy caused by the earthquake. In order to absorb the energy, the building must deflect and in most cases, the deflection involves the use of the material beyond the elastic limit.

There are many projects related to the development of theoretical, analytical methods to predict the response of structures to seismic forces. The evolution of current projects investigating the inelastic response of structures is a continuation of previous work which considered the elastic response of the structure. Dr. Housner of California Institute of Technology is credited with the methodology for the determining linearly elastic behavior of structures and many subsequent researchers are now investigating the inelastic response of structures, as a function of time for a specific earthquake shaking and also as a function of the assumed mechanical properties of the materials.

Dr. Ray Clough, of the University of California, Berkeley, pioneered the use of finite element analysis methods used to determine the dynamic response of various types of structures such as dams and buildings. Other researchers are using Clough's technique to investigate the seismic response of other types of structures. Among these researchers are Dr. Brown of University of Washington who is developing improved methods to evaluate the seismic safety of newly built and existing structures, using a probabilistic approach which takes into account the objective and subjective considerations for safety.

There are many projects at several universities concerned with the verification of theoretical concepts and construction methods of current practices. Foremost among these researchers is Dr. Bertero at the University of California, Berkeley who is investigating the inelastic behavior of full-size components and small scale subassemblies of reinforced concrete; and Dr. Sozen at the University of Illinois who is investigating the inelastic behavior of structures using small scale prototype models subjected to seismic excitations when placed on an earthquake simulator. Other universities are investigating the behavior of materials subjected to dynamic loadings to determine the basic physical properties of the material. Dr. Jirsa at the University of Texas, Austin is a leader in this field.

### (4) Construction

A necessary activity of theoretical development is the proof of concept and verification of the basic assumptions used to develop the theory. Advances in experimental methods and techniques have accompanied the theoretical developments. The previously used method of unidirectional monotonic loading equipment has been replaced by activators which can apply cyclical loadings to structural components and building systems, to provide quasi-seismic forces representing earthquake motions. These techniques have provided experimenters with a method of determining the response of structures and materials in such a manner that the cyclic effect can be studied in detail to confirm and/or revise the theoretical concepts.

One of the major objectives of earthquake engineering is predicting the response of structures subjected to severe earthquake excitation. While considerable effort has been devoted to developing computer programs for performing such analyses, it soon became apparent that much more detailed information on the actual damage performance of such components was needed to validate the programs before reliable computer predictions could be made.

The general approach has been to develop testing facilities capable of subjecting structures to similated earthquake loadings, to measure the performance of a variety of structures during such tests, and to use the experimental results in defining mathematical models which reliably and accurately represent the observed performance. Previously, the approach to structural response analysis was to model each of the members or components which comprise the complete structure and then to mathematically assemble these component models so that they simulate the behavior of the complete structure. However, the effectiveness of this approach can only be tested by correlation of the analytically predicted behavior of complete structures with observations of the performance of the complete structures on a simulator table or actual earthquake. For this reason, a major aspect of the total NSF research effort has been directed toward observations and evaluations of the seismic behavior of complete building systems assembled from a number of structural elements and components which have been tested as units and/or subassemblies.

The principal experimental facility which has been developed for study of complete structures is the Earthquake Simulator Facility at the University of California's Richmond Field Station which first began its pilot runs in 1972 and has been in full operation since March 1973. The facility is under the direction of Dr. McNiven. The central feature of the facility is the 20 x 20 feet "shaking table" or earthquake simulator. The table, on which test structures on components are placed, can move in the vertical and one horizontal directions. Test structures weighing up to 100,000 pounds can be subjected simultaneously to horizontal and vertical motions of approximately twice the intensity of those experienced in the 1940 El Centro quake.

The shake table has been effective in testing connection assemblies and components of buildings, bridges, storage tanks, storage racks, and other types of structures.

One of the recent tests was to subject a model of the three-span, curved, reinforced concrete bridge which failed during the San Fernando earthquake. The experimental program included a study of the dynamic response of the bridge to seismic excitations to verify the theoretical analysis and computer program, and to study the behavior of retrofit methods which have been developed to provide a continuous supporting mechanism to the bridge superstructure in order to avoid a collapse. This investigation was under the supervision of Drs. Penzien and Clough of the University of California, at Berkeley.

Another unique project for the Simulator was the shake test of industrial storage racks. Dr. Scholl of the John A. Blume & Associates Company directed the project in which an analytical computer program was developed and the racks tested on the table to confirm the analytical assumptions. The shake tests indicated that changes in the manufacturing process and installation of the racks were required before they could be considered seismically resistant. The analysis could not possibly take into consideration the lack of sufficient welds at the juncture of members, nor accurately include the effect of torsional flexibility of the column struts at the fixity of the base to the foundation. As a result, the computer program was revised, the manufacturing process changed to suit the seismic needs and the methods of installation improved.

## (5) Rehabilitation

Unusually high rates of structural damage and personal injury during an earthquake are quite possible for the large inventory of existing buildings in seismic regions of the country. Many of these buildings were constructed long before seismic requirements were required and consequently are not expected to withstand an earthquake of significant proportions.

The largest segment and most vulnerable of these existing buildings are the unreinforced masonry types ranging from the one story structure to the medium high-rise types , these buildings are generally residential types such as schools, apartments, nursing homes, senior citizens homes and commercial office buildings. Although some small industry plants and warehouses are in this category.

Because of the extreme vulnerability of these types of buildings to seismic damage, a coordinated program was initiated to develop the technical data and knowledge to rehabilitate the buildings and also to provide guidance for the seismic-resistant construction of new buildings of the same types.

The following awards are indicative of the recent steps taken to begin approach to the problem.

1. A national workshop was conducted on September 13-16, 1976 on the general topic of "Earthquake Resistant Masonry Construction," at the National Bureau of Standards (NBS), Boulder, Colorado. The principal objective of the Workshop were:

    1. To review the deficiencies and establish priorities for future research.

    2. To assess the accomplishments of masonry research as it applies to the development of improved or new design criteria.

    3. To initiate a continuing liaison between the various research laboratories and other professional groups concerned with masonry construction.

    As a result of the Workshop, a Proceedings was published and distributed widely to researchers and professionals. The Proceedings included technical reports of research, discussions and recommendations for future research.

    The principal investigators were Dr. Robert A. Crist and Louis E. Cattaneo, NBS.

2. The accomplishments of masonry research such as analytical studies, experimental data, design criteria and code provisions were assembled in a 3-inch thick Proceedings Report which resulted from the North American Masonry Conference. This Report was widely distributed, because it is the compilation in one volume of all masonry research and design experience in the United States.

   This Report serves to notify researchers, practitioners, and code bodies of the research which has been completed and the resulting available data.

   Project was administered by Dr. James L. Noland of the consulting engineering firm of Atkinson-Noland, Inc. of Boulder, Colorado.

3. It became evident from the Reports of the two conferences noted that the question of repair and strengthening of existing unreinforced masonry buildings was of prime importance to the rehabilitation of these buildings. To determine the sepcific areas of needed research, Dr. Robert D. Hanson, University of Michigan, conducted a Workshop on the "Repair, Strengthening and Rehabilitation of Buildings - Recommendations for Needed Research" in October 1977.

4. As a result of the Workshops, projects were initiated to investigate various topics of needed research:

   a) Reliability of Existing Buildings in Earthquake Zones - by James T.P. Yao, Purdue University; Objective is to develop a capability to predict the behavior (and, therefore, safety) of buildings subjected to earthquake forces.

   b) Fire Research on Epoxy Repaired Concrete Structures - Joseph M. Plecnik, California State University, Long Beach; This project developed data for the repair of concrete buildings damaged by earthquakes. The data forms the basis for code requirements by the Structural Engineers Association of California.

   c) Vibration Testing of an Epoxy-Repaired Four Story Concrete Structure - Roger Scholl, Project Director, John A. Blume and Associates, Engineers; This project tested the repaired structure to verify the dynamic response with the epoxy-repairs compared with the behavior of the original structure to determine the loss of strength, the change in natural frequencies, and the change in deflections. The data is under study but the results appear to be highly satisfactory.

d) Cyclic Response of Masonry Anchor Bolts -Russell H. Brown, Clemson University; An important consideration in determining the safety of unreinforced masonry buildings is the strength of the various anchor bolts used to connect the floors and roofs to the walls. This strength of these connections subjected to seismic type forces must be known in order to evaluate the safety of the building as a whole system.

e) Methodology for the Mitigation of Seismic Hazards in Existing Unreinforced Masonry Buildings - Robert Ewing, ABK-a joint venture of three small business organizations; The objectives are to assess and evaluate the current methods and codes to mitigate the seismic hazards of eixsting unreinforced masonry buildings, and to develop an analytical methodology to mitigate the hazards. A major phase of this project is the verification of theory by testing floor diaphragms of various types and materials and their connections to msonry walls when subjected to seimic forces. Repair methods will be investigated during the testing phase.

f) Methods of Non-Destructive Evaluation of Masonry Structures - James L. Noland, Atkinson-Noland and Associates, Inc.; There is a need to determine the strength properties of unreinforced masonry buildings in order to evaluate the safety of the building without damaging the structure for the data. Several non-destructive methods will be investigated to determine their reliability, costs and ease of application.

g) Reliability of Existing Buildings in Earthquake Zones - Hugh D. McNiven, University of California, Berkeley; This project is investigating the strength and behavior of masonry piers and girders subjected to seismic forces.

h) Connections in Concrete Masonry Buildings Under Seismic Forces - Gilbert A. Hegemier, University of California, San Diego; The first phase investigated the theory and experimental behavior of structural masonry walls subjected to seismic forces. This phase is investigating the various types of connections for walls to floors and roofs, intersecting walls, and corner wall connections. The data will verify the theory used to predict and design these types of buildings to be earthquake resistant.

i) Conference on Research in Progress on Masonry Construction - James L. Noland, Atkinson-Noland and Associates, Inc.: At the initial Workshop, a need for researchers to discuss ongoing projects was expressed. With the number of current projects under investigation, a general conference for all researchers is planned in order to have everyone discuss their research and solicit suggestions and questions on the progress and direction of the investigation. Of equally great importance is the exchange of information among researchers and practitioners in order to avoid duplication of activities and to provide data for others to build upon and use in their respective projects. This Conference will be the first of its type and it is expected to serve as a model for other researchers to duplicate.

The data developed will enable an engineer to evaluate the strength of an unreinforced masonry building and to determine the best method for rehabilitation of existing buildings as well as providing techniques for new designs.

## B. MODEL CODES - DEVELOPMENT OF TENTATIVE PROVISIONS FOR SEISMIC REGULATIONS FOR BUILDINGS

In June of 1978, a document was published which represents a significant achievement in incorporating some of the knowledge developed through basic and applied research over a period of 15 years in a format to guide the revision of building construction codes. This document entitled, "Tentative Provisions for the Development of Seismic Regulations for Buildings," was prepared with funding from NSF by the Applied Technology Council, and the Center for Building Technology of NBS. The development of this document, referred to as the ATC-3, involved the cooperative effort of engineering seismologists, engineering researchers and practicing engineers.

The ATC-3 embodies a number of new concepts which are significant departures from previous seismic design provisions. Among these are:

- incorporation of more realistic seismic ground-motion intensities,
- consideration of the effects of distant earthquakes on long-period buildings,
- response modification coefficients to take into account past performance of various framing systems,
- establishment of "seismic hazard exposure groups" for different types of structures,
- improved response coeffient formulas for simplified analysis of non-critical buildings,
- the use of quasi-dynamic methods for important buildings,
- initial recommendations for seismic design of architectural, electrical and mechanical systems and components, and
- initial guidelines for assessment of existing structures.

This ATC-3 document makes available to designers and public officials a significant improved set of procedures and regulations than previously existed. Adoption of this information will provide a significant reduction in hazards associated with earthquakes.

## C. SOCIETAL RESPONSE

The Societal Response element has facilitated important achievements in each of the coherent areas in which most of the funded activities are grouped: i.e., the socioeconomic aspects of mitigation and preparedness, hazard information dissemination and warning, and disaster impacts and responses. As a result of work funded by NSF in the mitigation and preparedness area, important advances have been made in the understanding of the social, political and legal factors working against the adoption and implementation of building standards and land-use regulations and problems related to public acceptance of earthquake insurance. In the disaster impacts and responses area, recent advances have been made in the development of knowledge on the short- and long-term effects of disasters, including such impacts as inflation, as a result of research by social scientists at Northwestern University, the University of Massachusetts and Colorado State University.

The work supported by NSF in the dissemination and warning areas has also had significant payoff. Results from research on disaster warning and hazard information dissemination are finding their way into organizations with warning responsibilities like NOAA. Private groups are also benefiting from the projects supported by NSF. For example, the National Association of Broadcasters relied upon results from such investigations to develop guidelines for disaster broadcasting. To facilitate the exchange of vital information between research producers and users, NSF has encouraged researchers to include users on their project advisory committees. Thus, a major project on disaster warning at the University of Minnesota has representatives from NOAA on its advisory committee, and the NSF-funded study at the National Academy of Sciences by the Committee on Disasters and the Mass Media includes representatives from NOAA, USGS and the National Association of Broadcasters. As a result of such strategies and the activities of the Natural Hazards Research and Applications Information Center, there is more exchange between researchers and users in the field today than at any previous period. The significant activities at the Information Center include conducting workshops and conferences, and preparing and distributing a quarterly publication on hazard research and programs to over 5,000 persons in government and the private sector.

Advances are also being made in the work supported by NSF on the socioeconomic aspects of earthquake prediction and warning, which is a sub-area of the dissemination and warning activity. Because the research on the socioeconomic aspects of earthquake prediction illustrates how the Societal Response activity complements the technical research on earthquake hazards mitigation, the accomplishments of one NSF supported social science study on prediction will be discussed in some detail.

There is consensus in the scientific community that reliable forecasts of potentially destructive earthquakes will be possible in the future. Long-term predictions of earthquakes will provide the opportunity for threatened communities to devise and implement vital mitigation and preparedness strategies. A few responsible organizations in the country, such as the U.S. Geological Survey, are already beginning to develop policies and measures related to earthquake prediction and warning.

However, maximum benefit will not be derived from the emerging technology of earthquake prediction until a complementary body of knowledge is developed by social scientists. This body of knowledge must address such questions as: How do people view the threat of earthquake and the potential for future earthquake prediction? How is information on earthquakes acquired? What are citizens willing to do themselves to prepare for earthquakes and what are they willing to have public officials do? Answers to these and similar questions are emerging for the first time from a three year study supported by NSF at UCLA under the direction of Ralph Turner.

Professor Turner's study, "Community Response to Earthquake Threat in Southern California," was launched to measure and monitor public reaction to the southern California Uplift near Palmdale and to assess related events. The Uplift first received widespread public notice following a story which appeared in the Los Angeles Times on February 13, 1976. Although seismologists did not know the exact meaning of the Uplift, they noted that such an anomaly is an important hypothetical precursor to an earthquake and that if it were a precursor, its extent could indicate a potential earthquake of a very large magnitude. Although the Uplift has not resulted in a true prediction, it is in some important ways analogous to a prediction situation. For example, the California Seismic Safety Commission issued a statement that the Uplift should be viewed as a threat to public safety in the Los Angeles metropolitan area. Also the U.S. Geological Survey increased instrumentation and observation in the uplifted area. Thus, as a near prediction, the southern California Uplift can provide insight into how the public might be expected to respond to a credible prediction and information on some of the problems that can be anticipated.

Data collection on Turner's study has been recently completed. The data collection efforts have included: a survey of 1450 residents of Los Angeles County interviewed in their homes and four telephone surveys to determine the feelings of the public after the announcement of the Uplift, a study of news media treatment of earthquake-related news and issues after the Uplift announcement, and a study of the public reaction to the 4.6 magnitude earthquake felt in the County on New Year's Day, 1979. Much of the data from this study is still being analyzed. However, it is already clear that the project is advancing our understanding of how the public perceives and responds to the threat of earthquakes, what is being done to mitigate their impact, and the problem likely to be encountered in getting the public to respond effectively to future predictions. For example, based on group differences uncovered on the awareness of the Uplift, the study suggests that consideration be given to undertaking special efforts to insure that young adults, the less educated, members of lower income levels and minority groups are made aware of future earthquake predictions. The researchers have been very active in advising mission organizations and keeping them informed of research results as they emerge. For example, inputs are being made to the California Seismic Safety Commission, which has the responsibility for advising the California legislature on earthquake mitigation policy, and the U.S. Geological Survey, which has the lead Federal role in developing and implementing earthquake prediction policy. And at the local level, results from the project served as part of the basis for the establishment of the Los Angeles Mayor's Task Force on Earthquake Prediction that was created to advise the mayor on earthquake prediction and preparedness policy.

## D. PROGRAMS WITH OTHER COUNTRIES

An important element of the National Earthquake Hazards Reduction Program is international cooperation on scientific activities such as exchange of data, equipment, personnel, joint research projects, conferences, workshops, and seminars. Significant efforts are being conducted in Japan, China, Taiwan, South and Central America and elsewhere in earthquake science and technology which complement the U.S. program. Collaboration represents an economy of time and financial resources which the program will continue to pursue.

The following significant accomplishments have been made:

### (1) Cooperation with Japan

Development of U.S.-Japan Cooperative Earthquake Program on Large-Scale Testing

-A long-term research plan to integrate the U.S. analytical and the Japanese experimental capabilities to study the dynamic behavior and seismic design of building joints, components, frame assemblies, and structural systems has been developed. In 1979, NSF signed a two-year implementation agreement via the U.S.-Japan Natural Resources (UJNR) Program with Japanese Ministry of Construction and Science Technology Agency. Research projects will be initiated in the spring 1980 in both U.S. and Japan.

### (2) Cooperation with USSR

-Through a project conducted by Professor A.K. Aki of MIT, field experiments of earthquake response of sediment-filled valleys in Garm. Tadyhikistan have been conducted. Actual earthquake data were received by the seismic stations operated in the region and are being analyzed by MIT. This study has led to improved understanding of seismic propagation, attenuation, site amplification, and wave coherence.

-Various scientific data, information and personnel have been exchanged from 1976 to the present through the US - USSR Cooperative Agreement in the Field of Housing and Other Construction.

-NSF and USGS have jointly supported a study of induced seismicity conducted by a US - USSR research team at the Nurek Dam Site, USSR. The U.S. project investigator is Dr. David Simpson of Columbia University.

### (3) Cooperation with The People's Republic of China (PRC)

-NSF, in collaboration with the USGS, FEMA, and other agencies, has developed a US - PRC Cooperative Earthquake Research Program to be implemented under the umbrella of the Scientific and Technology Agreement between the U.S. and PRC. A three-way earthquake protocol was signed in January 24, 1980 in Peking by the Directors of NSF, USGS and the PRC's State Seismological Bureau. This protocol and the annexes provide the program framework and specific research plans for the initial years. Several important cooperative research projects will be initiated immediately and implementation completed in 1980 and 1981 for studies in earthquake prediction, strong motion data and instrumentation, and other basic geophysical research.

### (4) Cooperation with Taiwan

-A sophisticated impedance function solution for the earthquake soil structure interaction problem has been obtained through research cooperation between scientists of the University of California (Berkeley) and National Taiwan University. This solution method, which yields accurate solutions in closed form, is being cross-compared with other methods such as the half-space method and finite-element method.

-A moderate-sized strong-motion instrument array consisting of 40 strong-motion digital accelerographs is being deployed in the high seismic region in northeastern Taiwan. This array is the first of such kind in the world. Potentially, data recorded in such array can lead to scientific breakthrough in strong-motion engineering seismology.

### (5) Cooperation with Other Countries

-A plan for a dense strong-motion array in Shillong, India has been developed. This array will be implemented as a cooperative effort with India.

-A dense array project for deployment is being developed in cooperation with Mexican representatives in Oaxoca, Mexico.

- Several other cooperative opportunities for earthquake hazards research are being developed with counterpart institutions and scientists from countries in Europe, Latin America and Southeast Asia.

## E. LEARNING FROM EARTHQUAKES

Data collection on the effects of major earthquakes is an important element in the mitigation procedures of future earthquakes. Essential information includes ground motion and structural response records, damage or lack of damage to structures and facilities, and the societal impacts of such disasters. Because rapid response is required to obtain the necessary information, NSF supports the Earthquake Engineering Research Institute (EERI) to maintain a post-earthquake team for such purposes, as well as the National Academy of Sciences (NAS) to provide similar information for related natural disasters (e.g., tornados, hurricanes). An example of such a learning experience is described below.

At 4:15 pm on October 15, 1979, an earthquake of Richter magnitude 6.5 and centered near Calexico, California, caused approximately 100 injuries and property damages on the order of $10-20 million. The earthquake was felt as far as 200 miles from the epicenter. The selective damages to various types of structures (buildings, bridges, storage tanks, canals, water towers, etc.) provided an opportunity to utilize and verify research results developed in previous years. The damages (or lack thereof), in conjunction with the extensive instrumentation in the area, will provide information to focus and accelerate future research in essential areas.

A brief summary of the post-earthquake activities participated in by NSF and grantee organizations is given below:

1. Dr. William W. Hakala, NSF, was dispatched to the earthquake site and prepared a preliminary report on the damages and the initial earthquake recovery.

2. To maximize learning from earthquakes, the Earthquake Engineering Research Institute (EERI) has established post-disaster survey teams on a regional basis. The regional team documented the damages and problems caused by the earthquake, and is presently preparing a report in a format that will be useful to those concerned with improving earthquake mitigation procedures. The team utilized the survey procedures developed through a previous NSF grant (Learning from Earthquakes).

3. Christopher Arnold, a research architect and President of Building Systems Development, Inc., San Francisco, is the Principal Investigator on a project that studies the earthquake impacts on hospital functions. He has also completed a project on the influence of building configuration on seismic resistance. Arnold was commissioned by the California State Board of Architectural Examiners to lead a team to survey the non-structural damages. Dr. Arnold has completed his report and submitted it to the Board.

4. George Mader of William Spangle and Associates, Portola Valley, California, is the Principal Investigator on a grant studying land use management for earthquake hazard mitigation. In this research, Mader has developed specific recommendations for reconstruction planning and management, and is working closely with FEMA representatives on the application of those research findings. He is now actively involved in the subject earthquake currently serving as Chairman of the California Seismic Safety Commission.

5. Prior to the earthquake, on an NSF grant, Professor J.D. Brune of the University of California, San Diego, had placed an array of instruments to record ground motions in the Calexico area. As a result, important records were obtained. Immediately following the earthquake, Dr. Brune dispatched a portable array of instruments to the area to record pertinent aftershock data.

6. The instrumentation described above supplemented the instrumentation of the U.S. Geological Survey in the area (also funded by NSF), and thereby resulted in the most complete of records ever obtained for a damaging earthquake. The ground motion data collected will greatly enhance our scientific understanding of earthquake source mechanisms, the nature of strong motion attenuation in geologic materials, and the relationship of strong motion to building damage.

7. In 1978, a research initiation grant was awarded to Dr. Gerald C. Pardoen, University of California, Irvine, to study the seismic resistance of the Imperial County Services Building. The building was severely damaged by the earthquake. The instrumentation placed in the building for the research should be invaluable in understanding the behavior of such structures subjected to seismic loading.

8. Several investigators, e.g., the John H. Wiggins Company and Professor J.T.P. Yao of Purdue University, who have been carrying on NSF supported research on the seismic damage potential for existing buildings, have made arrangements to document some of the actual damage to buildings which can be used as test cases for the methodologies being developed.

9. A special Universities Council for Earthquake Engineering Research (UCEER) Panel was convened in San Diego on November 3, 1979 to discuss research needs arising from the damaging El Centro earthquake. The meeting was preceded by a visit to the site of the earthquake and a survey of relevant damage, strong-motion instrument sites, and other features. The objectives of the Panel were: 1) to determine the need for near-term follow-up research, 2) to make individual investigators aware of this need and the

associated opportunities for meaningful research, 3) to estimate the scope of such research and examine both its importance and urgency, and 4) where possible to estimate the magnitude of the near-term research effort required. The recommendations of the Panel have been submitted in a report.

10. A number of proposals have been submitted to NSF as a result of the UCEER meeting discussed above. These proposals are presently being evaluated.

I think with that I would like to turn to Dr. Johnson. Before I do, however, I would like to introduce Dr. Donald Senich, who is sitting on my right. Dr. Senich is the Division Director for the Foundation's problem focused research activities and has direct responsibility for the earthquake hazards mitigation program.

Mr. BROWN. We are happy to have you here, Dr. Senich.

Dr. SENICH. Thank you, sir, and I will be prepared to answer the questions you have.

Thank you, Dr. Sanderson.

Mr. BROWN Dr. Johnson?

Dr. JOHNSON. Mr. Chairman, I am pleased to be here again today to discuss one of AAEO's programs that I did not touch on in my statement of February 6.

The AAEO portion of the U.S. Geological Survey-NSF earthquake hazard mitigation program, instituted in response to the Newmark-Stever Report of the Earthquake Hazards Reduction Act of 1977, lies in the geophysics program of our Earth Science Division.

The program is one of many in the AAEO directorate that accomplishes the twofold mission of supplying fundamental information and understanding about the planet on which we live, while at the same time providing information of great relevance to environmental problems of considerable societal importance The directorate is replete with other such programs and emphases; for example, the Earth Sciences Division is also concerned with research on mineral deposits, environmental chemistry, erosion, and flooding, as part of its role in trying to learn the details of the evolution of the Earth.

Like much of what we do, the AAEO research effort on earthquakes is investing for a return payable several years in the future. Fundamental studies must be constructed in such a way to give us the long-time base line required to distinguish anomalies from ordinary behavior in the major active seismic zones in the country.

I would now like to introduce to you Dr. Robin Brett, the Director of the Division of Earth Sciences, who will provide you with some details of the program and of the recent progress that has been made.

Thank you.

Mr. BROWN. Dr. Brett.

Dr. BRETT. Mr. Chairman, I would like to submit my written statement for the record and make some brief remarks summarizing that statement.

Mr. BROWN. By all means.

## STATEMENT OF DR. P. ROBIN BRETT, DIRECTOR OF DIVISION OF EARTH SCIENCES, NATIONAL SCIENCE FOUNDATION

Dr. BRETT. I am pleased to present these comments on the role of the geophysics program of the Division of Earth Sciences in the area of earthquake research. Seismology and other earthquake related areas of the study have been of long-term interest to the geophysics program and have, in fact, comprised more than half of its program since its inception some 20 years ago.

Aspects of this research, related to the USGS-NSF earthquake hazard mitigation program, have been intensified in recent years, in accordance with the recommendations of the Newmark-Stever report.

Since 1978 we have completely followed the funding recommendations of option B of that report, and this year plan to spend $6.6 million on the program. In fiscal year 1981 and afterward, we plan to support this important activity at a level corresponding to an increase of 10 percent per year—a level approximately sufficient to keep with inflation. Such a budget will allow us to continue high-priority activities.

From fiscal year 1977 through fiscal year 1979, the program has made 208 grants in this area. They were funded to 51 institutions in 27 States. We maintain close liaison with the program of the directorate of engineering and applied science, from whom you have just heard, and have cooperated in the support of some workshops and grants in the area of strong-motion research. In general, however, the content of the engineering and applied science program is quite different from the geophysics program. We also cooperate closely with the programs of other agencies in the area, especially those with the U.S. Geological Survey, both by personal contact by program staff and by liaison membership on each other's advisory committees and evaluation committees.

Plate motions and other interactions, as well as the earthquake process itself, are a fundamental and very important part of earthquake research. We divide them into two parts—the actual mechanisms and physics of the earthquake and the movements of the plates themselves.

Substantial advances have been made in each of these areas in recent years. These accomplishments were made possible by the acquisition of large amounts of very high quality geophysical data, and I think that these data and future data will ultimately help in the prediction part of the program. Fortunately, we have access to good computers and the availability of a group of talented and well-trained scientists.

I would just like to tell you now just few of the advances that have been made. The greatest expansion in theory has probably been in the procedures used to compute synthetic seismograms. This has required a good understanding of seismic sources, earth structure, and the wave transmission properties of the Earth. If we can understand a synthetic earthquake, then when we get a real one, we will be in a much better position to understand the processes that have been taking place, and identifying the characteristics of the individual quake. At periods greater than about 20 seconds, there is now in general terms a fairly complete understanding of all the details in a seismogram.

We have the beginning of an understanding of the dynamic process of faulting—how a fault rupture starts, spreads, and finally stops, and the effects seen on seismograms for each of these stages in the faulting process, which we then can tie into the synthetic seismograms which we are trying to develop.

A general picture of very large earthquakes is that they are multiple events. Rupture begins on a long fault, pauses momentarily, presumably on reaching a strong point on the fault, then proceeds, perhaps with several other jerks, before the total rupture is complete. That seems a rather simple-minded thing, but really it requires a lot of work to understand actually what is going on. It is a multistage process.

It has been hypothesized recently that there may be slow unfelt earthquakes that precede the more usual ones with which we are familar. If so, the observation of slow earthquakes would provide a predictor. We just sort of have a smell of these things and we are trying to pursue this as much as possible.

Most seismographs will not respond to such low frequencies. However, the network of 16 worldwide, ultralong period instruments supported by NSF and operated by scientists at the University of California, San Diego, is ideal for the recording of slow earthquakes. A search for their existence is being conducted currently, at least, at three other university research laboratories using data from this network.

Recently, there has been convincing evidence that a seismic gap concept, which was in the testimony of Dr. Menard, provides a valid indication of the sites of future large earthquakes on plate boundaries. We have known about the predictive potential of gaps for about 15 years, but we are getting to the stage where we can fairly certainly say that, at least on some gaps, there is going to be an earthquake.

A gap is a zone along an active fault that has not experienced a large earthquake compared to the frequency of previous large earthquakes along the fault. This frequency can be defined as 30 years. That is a common definition of a gap. Of course, the frequency varies with the fault.

Several recent large earthquakes have occurred along gaps—for example, the great big 1978 earthquake in Oaxaca, Mexico, which had a magnitude of 7.8 and which partially or completely ruptured that gap. According to gap theory, there should not be another major one in that area for some time.

The COCORP program for seismic reflection profiling of the continental crust relates to the earthquake problem in a variety of ways, ranging from the specific geological features that correlate with specific earthquakes to broader kinds of information on the structure of the crust and on crustal processes that must be understood. This as a series of trucks which make vibrations that go deep in the Earth, and from this technique we are beginning to understand the crust of the continental United States.

The ability to detect and trace faults deep in the Earth has been amply demonstrated in the southern Appalachians, Wyoming, California, Michigan, and New Mexico. The Appalachian study has given insight into the origins of the historic Charleston earthquake.

The results from recent work have indicated a number of important directions in which research should be currently focused. It is not possible to predict the content of a program of fundamental research in future years. We can only plan to continue and complete the most interesting and promising work currently in progress.

I could give you a list of things we are doing or would like to do, but I think I will proceed and just say that we feel that a diligent pursuit of the present program can be expected to result in a more comprehensive understanding of the earthquake process, which of course will help to establish the scientific base of knowledge necessary for the possible prediction of earthquakes and destructive ground motion. Thank you.

Mr. Brown. Thank you very much, Dr. Brett.

[The prepared statement of Dr. P. Robin Brett is as follows:]

STATEMENT OF
DR. P. ROBIN BRETT
DIRECTOR OF
DIVISION OF EARTH SCIENCES
NATIONAL SCIENCE FOUNDATION
BEFORE THE
SUBCOMMITTEE ON SCIENCE, RESEARCH, AND TECHNOLOGY
OF THE
COMMITTEE ON SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

February 27, 1980

Mr. Chairman and Members of the Committee:

I am pleased to present these short comments on the role of the Geophysics Program of the Division of Earth Sciences in the area of earthquake research. The Geophysics Program covers the sub-fields of seismology, gravity, geodesy, magnetism, earth currents, heat flow, and the behavior of natural materials at high pressures. Seismology is perhaps the most important area of geophysics in that it is the primary method of studying the structure and physical properties of the earth's interior and is a primary method of outlining the plates making up the earth's lithosphere and of studying the detailed structure of the earth's interior. As such, seismology and other earthquake related areas have been of long term interest to the Geophysics Program and have in fact constituted more than half of its program since its inception some 20 years ago.

Aspects of this research, related to the USGS-NSF Earthquake Hazard Mitigation Program, have been intensified in recent years in accordance with the recommendations of the Newmark-Stever Report.

Specifically, we have completely followed the funding recommendations of Option B of that report, as follows, allotting $5.3M in FY 78, $6.0M in FY 79, and $6.6M in FY 80. In FY 81, and following, we currently plan to support this important activity at a level corresponding to an increase of 10% per year -- a level approximately sufficient to keep up with inflation. Such a budget will permit the continuation of high priority activities.

From FY 77 through FY 79 the Program has made 208 grants in this area. They were funded to 51 institutions in 27 states.

We consider our role in the earthquake program to be an essential ingredient of the overall effort, because we feel that earthquake prediction must be based on a rather thorough understanding of the physical processes involved; we are clearly not yet in that position. We maintain close liaison with the predominantly earthquake engineering program of the Directorate of Engineering and Applied Science of the Foundation, and we have cooperated in the support of workshops and grants in the area of strong motion research.

In general, however, the content of the Earthquake Hazards Mitigation Program of EAS is quite distinct from that of the Geophysics Program. Close coordination between the Geophysics Program, the earthquake prediction program of the USGS, and with the earthquake research programs of other agencies is of even greater importance. This is attained by close personal contacts of Program personnel and by liaison membership on each other's

Advisory Committees and Evaluation Committees.

The NSF program in Fundamental Earthquake Studies comprises in-depth studies and measurements directed at the development of a new understanding of the natural phenomena involved. Since most large earthquakes are caused directly or indirectly by stresses set up in the great lithospheric plates of the earth as they move relative to one another, the understanding of plate motions and interactions is a fundamental and very important part of earthquake research. Therefore, the Fundamental Earthquake Studies Program of NSF was, rather arbitrarily, divided into two sub-elements in the Newmark-Stever Report: (1) the earthquake Process, and (2) the Implications of Plate Tectonics, with considerable overlap between them. Substantial advances have been made in each of these areas in recent years. These accomplishments were made possible by the acquisition of large amounts of very high quality geophysical data, access to good computers, and the availability of a cadre of talented and well trained scientists.

The greatest expansion in theory has probably been in the procedures used to compute synthetic seismograms. This has required a good understanding of seismic sources, earth structure, and the wave transmission properties of the earth. At periods greater than about 20 seconds, there is now, in general terms; a fairly complete understanding of all the details in a seismogram. We have the beginning of an understanding of the dynamic process of faulting -- how a fault rupture starts, spreads, and finally stops, and the effects seen on seismograms for each of these three stages in the faulting process.

A picture of very large earthquakes that has emerged as probably being quite general is that they are multiple events. Rupture begins on a long fault, pauses momentarily, presumably on reaching a strong point on the fault, then proceeds, perhaps with several other jerks, before the total rupture is complete.

There has always been some doubt whether complexity on seismograms is related primarily to earth structure or to the complexity of the source region of the earthquake. It is now more clear that the latter is correct.

A number of experimental studies have been undertaken in recent years which bear on the earthquake mechanism. An earthquake is produced by sudden stress release, and so far only two phenomena have been seriously considered for geological materials under crustal pressure and temperature, namely brittle fracture of solid material and intermittent sticking and slipping on pre-existing faults. Recent work has concentrated on the latter. Two processes have been identified which produce such stick-slip: (1) fracture of irregularities along the fault plane, and (2) grinding on the other side of the plane due to these irregularities. This process is known as identation creep.

The presence of ground up rock or gouge along a fault plane has been presumed to have a significant effect on subsequent faulting. Laboratory studies have been made on the properties of actual and simulated fault gouge. Although gouge tends to reduce the amplitude of stick-slip over that on clean faults, stick-slip has been observed in thin layers of both clays and crushed silicate rocks.

It has recently been hypothesized that there may be "slow" unfelt earthquakes that precede the more usual ones with which we are familiar. If so, the observation of "slow" earthquakes would provide a predictor. Most seismographs will not respond to such low frequencies. However, the network of 16 worldwide, ultra-long period instruments supported by NSF and operated by scientists at the University of California, San Diego, is ideal for the recording of "slow" earthquakes. A search for their existence is currently being conducted at at least three other university research laboratories, using data from this network.

As previously stated, fundamental studies of earthquakes and the evolving theory of plate tectonics are intimately related. The major earthquake zone of the world mark the plate boundaries. The relative plate motions provide an adequate source for the energy released in plate boundary earthquakes and a basis for estimating how often great earthquakes should occur in these settings. On the other hand, the earthquake source properties provide information concedrning the amounts and directions of the relative plate movements and the stress systems involved. Recently there has been convincing evidence that a "seismic gap" concept provides a valid indication of the sites of future large earthquakes on plate boundaries. A gap is a zone along an active fault that has not experienced a large earthquake compared to the frequency of previous large earthquakes along the fault. Several recent large earthquakes have occurred along gaps, for example the 1978 earthquake in Oaxaca, Mexico, partially or completely ruptured that gap.

The COCORP program for seismic reflection profiling of the continental crust relates to the earthquake problem in a variety of ways ranging from the specific geological features that correlate with specific earthquakes to broader kinds of information on the structure of the crust and on crustal processes that must be understood if earthquakes and the earthquake mechanism are to be understood. The ability to detect and trace faults deep in the earth has been amply demonstrated in the southern Appalachians, Wyoming, California, Michigan and New Mexico.

It almost goes without saying that liaison and cooperation has been maintained between the research program of the United States and those of other countries that have significant programs in this area, i.e. Japan, USSR, China, and Taiwan. A specific protocol for scientific and technical studies beteen the NSF, USGS and State Seismological Bureau of the PRC was signed in January in Peking.

Results from recent work have indicated a number of important directions in which research should currently be directed. It is not possible to predict the content of a program of fundamental research in future years. We can only plan to continue and complete the most interesting and promising work currently in progress, realizing that the actual work over the next few years will be guided by major discoveries that emerge, often unpredictably.

There are many new initiatives that we would like to pursue. From a list of some twenty, I have chosen the following:

(1) Evaluation of the theory of seismic gaps and its seismogenic potential.

(2) Increased seismic reflection profiling of the continental crust in areas of particular earthquake interest.

(3) More laboratory study of rocks with special emphasis on fault gouge and the brittle-ductile transition.

(4) Development of effective techniques to compute synthetic seismograms for 2 and 3 dimensional structures.

(5) Development of ocean bottom seismometers and drill hole seismometers both on the continent and under the oceans for very long-term recording.

We feel that a diligent pursuit of the present program can be expected to result in a more comprehensive understanding of the earthquake process and will help to establish the scientific base of knowledge necessary for the eventual prediction of earthquakes and destructive ground motion.

Mr. **Brown**. Gentlemen, I don't think it is appropriate particularly for us to attempt to do more than understand the significance of the scientific developments that are taking place in this area.

What we are concerned about is the general problem of whether we are proceeding along the course which is contemplated in existing legislation, toward achieving some of the goals that were intended.

As I mentioned earlier, essentially, what we are trying to do is follow the plans set forth in the so-called Newmark report or to use that as a benchmark, at least, to measure what we are doing.

I gather from your testimony, Dr. Sanderson, that you feel that the Foundation is pretty much on the course set forth by this report 3 years ago, 4 years ago?

Dr. **Sanderson**. No, Mr. Brown, I did not want to convey that impression. The Foundation and the executive branch made the decision to follow option B of the Newmark report a number of years ago.

The authorizing legislation in the Earthquake Hazards Mitigation Act was closer to option A.

The Foundation submitted a request following the option B budget for a number of years. The part of this program in fundamental research under Dr. Johnson has continued at the option B level through this year's budget.

The program in the engineering and applied science research and, particularly, in the societal response research has been considerably reduced beginning in fiscal year 1978. Particularly severe was the reduction which occurred in fiscal year 1979 in the societal response element. That reduction was a result of congressional action in the appropriations for that program. As a result, in fiscal year 1979 and fiscal year 1980, the budget requests which you received from the Foundation were substantially below the Newmark option B.

I think I would like to emphasize a couple of points on that. We have at least managed in the engineering area to be on the option A curve, although we are certainly falling below that in the societal response area.

More importantly, if you look at the funding history in the program going back to around fiscal year 1976, it reflected a fairly steady and firm rate of growth, until the year that the budget was abruptly cut in the societal response area. One of the problems you are seeing is one that the Foundation emphasizes over and over again. Equally as important as the level of funding in these programs is the continuity of funding. We have devoted considerable effort to building research agenda in the societal response area, but because of the cuts mentioned earlier and we were literally forced to decline proposals before they were reviewed because there were no funds available to support them.

I think there are certainly opportunities for the Foundation to move its programs back up into the levels of support that had been proposed. Indeed, in the long-range planning materials that you have been supplied, you can see some of our plans for moving back toward the funding levels anticipated in the legislation. But, I think I have to emphasize that it is going to take time to get back, and it is going to take a continuity of effort. The off-again/on-again funding is not going to be as productive as a, perhaps, slightly lower but consistent level of funding in attacking these problems.

Mr. **Brown**. I appreciate that frank and clear description of the situation, Dr. Sanderson.

I am looking at a table here which shows the proposed budget figures in the category of societal response for the period 1980 to 1984. This is what you are referring to, at least in part, by indicating that you wanted to get back toward the level that was originally——

Dr. **Sanderson**. Yes, I believe that document is labeled "A Program for Earthquake Prediction and Hazard Mitigation" from the directorate, that has a budget summary for societal response, in the last page.

Chairman **Brown**. Yes, that is right.

Dr. **Sanderson**. It has a budget plan for 1980 to 1984, in draft form.

Chairman **Brown**. The figures look reasonable from my own admittedly imperfect perspective.

I would like to put this in the record. If there are no objections to that, this will be made a part of the record at this point.

[National Science Foundation draft of fiscal year 1980–84 budget plan follows:]

# INDEX

## National Science Foundation

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## VI. Societal Response Element

Research in this area focuses on the social, economic, legal and political factors related to the adoption of adjustments to earthquake hazards. The main purpose of this research, which complements the engineering and geophysical research conducted under the other elements of the Earthquake Hazards Reduction Program, is to develop and evaluate measures which individuals, private groups and government can use to mitigate and respond to earthquake impacts. These measures include emergency preparedness, land use planning, building codes, insurance, and information and education. Additionally, this research attempts to develop knowledge to improve earthquake prediction and warning, relief and rehabilitation, and long-term recovery. It is important that all of these measures and processes receive thorough attention from researchers so that a proper balance among social adjustments to earthquake can be achieved in threatened areas of society.

Modifications in building codes and land-use regulations and the issuance of earthquake predictions and warnings can have major social, economic, legal and political consequences. Whether such measures have a positive effect in mitigating hazards, or are overlooked altogether, may depend on the method in which the public or decision makers are informed about them. Also the adoption or nonadoption of disaster response plans by government and private entities, as well as the utilization of earthquake insurance, can be attributed to socioeconomic factors which as yet are not fully understood.

### Objectives

The major objectives of the Societal Response element are to:

VI. 1. Develop knowledge on the socioeconomic aspects of hazards mitigation.

VI. 2. Increase the base of knowledge on preparedness for earthquakes and other hazards.

VI. 3. Improve the understanding of disaster impacts and responses.

VI. 4. Provide a basis for improving the dissemination of information on earthquake hazards and its utilization by decision makers and the public.

### Accomplishments

NSF has helped to significantly expand the core of researchers investigating the socioeconomic aspects of hazards. Both young and senior researchers from the social sciences and related disciplines have been attracted to the field, giving it a new diversity and utility. NSF has also furthered the interaction of researchers with policy makers at all levels of society and in both the public and private sectors by supporting various technology transfer programs, including the Natural Hazards Research and Applications

Information Center at the University of Colorado. These developments have resulted in a number of other accomplishments, including the following.

Knowledge on Disaster Impacts and the Effects of Existing Policies:

Recent NSF supported studies have advanced our knowledge on the short- and long-term impacts of disasters on communities in the United States. Such studies are necessary for providing a basis for evaluating existing policy and for formulating new ones. For example, after completing a study on the impact of disasters which struck between 1960 and 1970, researchers at the University of Massachusetts have suggested that Federal relief policies appear to have been adequate during that decade. However, they have recommended that Federal officials consider formulating relief policies that give more attention to average-size disasters, in contrast to the catastrophic variety, since it is following the former type that they are more frequently called upon to provide assistance.

Attitudes Toward and Responses to Mitigation:

Mitigation is the key in dealing with the problem of earthquakes and other natural hazards. Thus policy makers need to know the public's attitudes toward mitigation and people's willingness to support such efforts. As a result of recently completed and ongoing work supported by NSF, including a nationwide study, the first reliable picture is emerging on what the public and decision makers are doing and are presently willing to do with regards to both structural and nonstructural mitigation measures. Such information is already being channeled to policy makers who have the responsibility for devising workable mitigation approaches.

Hazard Information Dissemination and Warning:

NSF has funded several studies relating to hazard information dissemination and warning, including research at the University of California, the University of Colorado, and the University of Minnesota. Such work is important because it provides a basis for modifying existing dissemination programs and for creating new ones. Organizations with warning and dissemination responsibilities like USGS and NOAA have benefited from projects supported by NSF in addition to private groups like the National Association of Broadcasters, which relied upon findings from such studies to develop guidelines for broadcasting in disasters.

NSF funded projects have also sensitized policy makers to the many socioeconomic and legal issues related to future earthquake predictions and warnings. This work, for example, helped set the stage for the formation of the California Advisory Panel on State Government Response to Earthquake Prediction and the Los Angeles Mayor's Task Force on Earthquake Prediction. And partially as a result of findings from a project conducted by the Association of

Bay Area Governments on government liability for earthquake mitigation actions, the California Legislature has considered a bill which would limit the liability of government officials when they take reasonable actions to mitigate the impact of earthquakes.

VI. 1. Objective: Develop knowledge on the socioeconomic aspects of hazards mitigation.

Strategy: Many known earthquake hazards mitigation measures are never adopted or adequately implemented in communities--at-risk. This is partly due to the fact that the impact and relative effectiveness of various measures are not as well understood as are the incentives which lead to their adoption. The strategy is to support social science and interdisciplinary research to determine the impact of various adjustments, their relative effectiveness, and the socioeconomic factors which influence their adoption and implementation.

Tasks:

VI. 1.1. Study how people and organizations establish acceptable levels of risk for low-probability and potentially catastrophic events.

VI. 1.2. Conduct comprehensive cost-benefit analyses of alternative adjustments applicable to decisions at the individual, group and community levels.

VI. 1.3. Study the economic, political and legal incentives and disincentives to correct or eliminate existing hazardous conditions. This includes the availability of public and private financing.

VI. 1.4. Assess the impact of mitigation measures on public and private attitudes and practices.

VI. 1.5. Evaluate the effectiveness of regulations (e.g., building codes, land-use controls, occupancies) to achieve given levels of earthquake protection.

VI. 1.6. Evaluate the effectiveness of financial regulations and practices (e.g., insurance, mortgage and taxation policies) to achieve given levels of earthquake protection.

VI. 1.7. Examine legal issues likely to be encountered in the application of earthquake mitigation procedures.

Base Program: In order to achieve this objective, all seven of the indicated tasks need to be completed. Under the base program, only the first four tasks would be carried out during the five year period, resulting in the program falling short in increasing knowledge on the socioeconomic aspects of mitigation.

VI. 1.A. Increment: Increases in the base budget over the next five years will permit expansion of the research on the socioeconomic aspects of mitigation and allow for the completion of the final three tasks. The addtional funding should result in research which provides decision makers with a firmer basis for arriving at policy decisions on earthquake hazards reduction.

Budget for Objective VI.1.: The budget for the objective, with proposed incremental increases in parentheses, is as follows:

| | Fiscal Year | | | | |
|---|---|---|---|---|---|
| Activity | 80 | 81 | 82 | 83 | 84 |
| | Millions of Dollars | | | | |
| VI.1. Socioeconomic Aspects of Mitigation | .3 | .8 | .8 | .9 | .9 |
| VI.1.A | | (.6) | (.7) | (.2) | (.2) |
| TOTAL | .3 | 1.4 | 1.5 | 1.1 | 1.1 |

VI.2. Objective: Increase the base of knowledge on preparedness for earthquakes and other hazards.

Strategy: Adequate attention has not been given by the research community to problems related to disaster preparedness. It is especially important to focus on this area now in order to take advantage of opportunities for preparedness which might be provided by the developing technology of earthquake prediction. The strategy will be to support research - including social surveys, comparative case studies and field investigations - on preparedness and the socioeconomic consequences of earthquake prediction.

Tasks:

VI. 2.1. Investigate earthquake preparedness planning at the local, State and Federal levels.

VI. 2.2. Study problems experienced by relevant professional groups, including architects, engineers and seismologists, in carrying out mitigative and preparedness functions.

VI. 2.3. Evaluate State and Federal government earthquake prediction and warning policies and procedures.

VI. 2.4. Socioeconomic monitoring of communities following earthquake predictions and near predictions (including both public and private sectors) to evaluate their impact.

VI. 2.5. Examine the social, economic, legal and political aspects of earthquake predictions in the United States and, when appropriate, overseas and develop recommendations for maximizing the benefits of prediction.

Base Program: Only the first three tasks would be carried out under the base program. While these tasks are important, their completion would result in only a partial achievement of the objective.

VI. 2.A. Increment: With the proposed increases, the remaining two tasks related to earthquake preparedness and planning would be completed. Their completion should increase the benefit the society will derive from the development of earthquake prediction.

Budget for Objective VI.2.: The budget for this objective, with incremental increases in parentheses, is as follows:

| | Fiscal Year | | | | |
|---|---|---|---|---|---|
| Activity | 80 | 81 | 82 | 83 | 84 |
| | | Millions of Dollars | | | |
| VI.2 Preparedness | .3 | .7 | .7 | .6 | .6 |
| VI.2.A | | (.5) | (.4) | (.2) | (.2) |
| TOTAL | .3 | 1.2 | 1.1 | .8 | .8 |

VI.3. Objective: Improve the understanding of disaster impacts and responses.

Strategy: An inadequate data base exists on how earthquakes and other disasters effect victim populations in both the short and long run. Responsible officials need such information in order to design effective countermeasures. The strategy is to support social science and interdisciplinary research on disaster losses suffered by individuals, groups and organizations in the United States and to evaluate the social and institutional responses to disaster-generated problems.

Tasks:

VI. 3.1. Conduct studies on the extent and distribution of losses from earthquakes and other hazards in the United States.

VI. 3.2. Examine the trade-offs between the provision of post-disaster relief and rehabilitation and financial assistance for pre-disaster hazard reduction.

VI. 3.3. Conduct post-disaster audits following events in the United States and overseas to collect information on the consequences of major disasters.

VI. 3.4. Conduct longitudinal studies of responses of individuals, families, public agencies and financial institutions to disaster events. Such studies should include all aspects of the pre- and post-disaster periods as well as very long-term responses.

VI. 3.5. Examine reconstruction problems following major earthquakes.

Base Program: The base program budget would permit the performance of the first three tasks. At this level of funding, those activities related to the analysis of long-term disaster-generated problems would not be undertaken, in spite of the fact that this area is little understood.

VI. 3.A. Increment: The proposed increment would make it possible to carry out the remaining two tasks under this objective. This research will be useful in identifying alternative disaster recovery approaches and policies.

Budget for Objective VI.3.: The budget for this objective, with incremental increases in parentheses, is as follows:

| Activity | Fiscal Year 80 | 81 | 82 | 83 | 84 |
|---|---|---|---|---|---|
| | Millions of Dollars | | | | |
| VI. 3. Disaster Impacts and Responses | .2 | .6 | .6 | .5 | .4 |
| VI.3.A | | (.5) | (.5) | (.2) | (.2) |
| TOTAL | .2 | 1.1 | 1.1 | .7 | .6 |

VI. 4. Objective: Provide a basis for improving the dissemination of information on earthquake hazards and its utilization by decision makers and the public.

Strategy: In addition to the research activities aimed at understanding and evaluating various hazard countermeasures, dissemination research will be supported. Also technology transfer and utilization activities will be supported. These include the preparation of guidelines and related materials for decision makers and the public, and workshops and other dissemination programs for local, State and Federal officials and relevant professional groups.

Tasks:

VI. 4.1. Evaluate existing hazard information dissemination programs.

VI. 4.2. Examine the role of the mass media in providing information

VI. 4.3. Conduct training programs (e.g., seminars and workshops) to further the adoption of mitigation measures in State and local government.

VI. 4.4. Conduct workshops with representatives of the private sector (e.g., engineers, architects, bankers, model code agencies) on methods of reducing earthquake losses.

VI. 4.5. Develop a prototype information program to acquaint the public with earthquake hazards mitigation measures.

Base Program: Only the first two tasks would be carried out under the base budget. Both of these tasks are important research activities. However, the important dissemination and utilization activities which should follow these research activities would not be undertaken at the base budget level.

VI. 4.A. Increment: With the proposed increases for the next five years, the three other tasks will be undertaken. Completion of these activities will facilitate the utilization of information on hazard countermeasures by relevant professional groups, government decision makers, and the public.

Budget for Objective VI.4. The budget for this objective, with proposed incremental increases in parenthese, is as follows:

| | | Fiscal Year | | | |
|---|---|---|---|---|---|
| Activity | 80 | 81 | 82 | 83 | 84 |
| | Millions of Dollars | | | | |
| VI. 4. Dissemination Research and Utilization | .2 | .4 | .4 | .5 | .6 |
| VI.4.A | | (.1) | (.1) | (.3) | (.4) |
| TOTAL | .2 | .5 | .5 | .8 | 1.0 |

Budget Summary

The following is the summary budget for Societal Response.

|  | Activity | Fiscal Year 80 | 81 | 82 | 83 | 84 |
|---|---|---|---|---|---|---|
|  |  | Millions of Dollars |  |  |  |  |
| VI.1 | Socioeconomic Aspects of Mitigation | .3 | .8 | .8 | .9 | .9 |
| VI.1.A |  |  | (.6) | (.7) | (.2) | (.2) |
| VI.2 | Preparedness | .3 | .7 | .7 | .6 | .6 |
| VI.2.A |  |  | (.5) | (.4) | (.2) | (.2) |
| VI.3 | Disaster Impacts and Responses | .2 | .6 | .6 | .5 | .4 |
| VI.3.A |  |  | (.5) | (.5) | (.2) | (.2) |
| VI.4 | Dissemination Research and Utilization | .2 | .4 | .4 | .5 | .6 |
| VI.4.A |  |  | (.1) | (.1) | (.3) | (.4) |
|  | TOTAL | 1.0 | 4.2 | 4.2 | 3.4 | 3.5 |

This is "draft, son of Newmark"

The ( ) figures are increments above the calculated base. So, for example in 1981 only elements VI 1, VI.2, VI 3 and VI could be carried out on $4.2 M. Note they are asking for 1.8 M for FY 81

Dr. **Sanderson**. While I don't want to comment specifically on its heritage, I do think it is a program plan which begins from the current level of research activity in the societal response area and begins to build at a reasonable rate that reflects our ability to start and conduct good research in the area without either expanding too fast or without neglecting opportunity. Dr. Anderson could comment on this. There is obviously some room for fine tuning, but I think you could sense where we are headed.

Mr. **Brown**. It is obviously impossible to predict, of course, what the Congress will do with a request for a program like this, but are we to assume that, at least as far as the Foundation and, hopefully, the OMB that this would represent the preferred plan of operation in this area?

Dr. **Sanderson**. Certainly from my point of view I feel this represents a very sound program. I have not discussed this plan in specific detail with FEMA or with the executive branch. The last guidance we had from them was that they still favored Option B of the Newmark Report. Since this budget is consistent with Option B, I would assume it is in their favor.

Mr. **Brown**. Dr. Sanderson, on the last page of your report, you make the statement that "we have made significant progress in research in the social sciences which addresses the crucial problems of understanding how people and communities respond to earthquake disasters" et cetera. How can you be so optimistic with so little money to spend in this area?

Dr. **Sanderson**. I have always said, given a $100,000, we will find the best grants to put it on. Therefore, I think with the small amount of money that we have, we have made remarkable progress.

There has been a number of activities which I think are particularly relevant to this. One of the interesting things is the effect of the Palmdale bulge because that gave us what in effect amounted to an artificial warning of an impending earthquake disaster, once the news reached the press that this bulge appeared.

So we had an opportunity not only to infer some societal response, but actually to observe behavior in that area. That observation was carried out with a significant time series of questionnaires, looking at some of the responses of the people in the area, the change to look at what happened to the economy of the area, and it provided some experimental verification for what we had been talking about.

Mr. **Brown**. How did you carry that out? Was that done by contract with some local organization?

Dr. **Sanderson**. All of our projects, Mr. Brown, are carried out by grants or contracts with research groups. As you remember, by law, we do not to our own research. If you would like the specific details on that one, perhaps Dr. Senich could give them to you.

Mr. **Brown**. I am interested in both the reaction to that particular event—the Palmdale bulge—and I am interested in how you approached that and research opportunity. If you could supply some information on it, I would appreciate it.

Dr. **Sanderson**. We can supply more detailed information for the record but, perhaps, Dr. Senich and Dr. Anderson would like to discuss that point.

Dr. **Anderson**. After the Palmdale bulge received a great deal of attention in the press in southern California in 1976, some researchers at the University of California, Los Angeles, came to us with the idea that this represented an opportunity to observe a community as it response to a potential earthquake prediction.

They suggested that we might provide the funding. Given our funding cycle, they found it necessary to get a starter grant from the U.S. Geological Survey of around $25,000. This provided them with the opportunity to develop a more complex long-term proposal to the Foundation.

After submitting a proposal to us through our unsolicited program, we provided initial funding in 1976, and subsequently provided additional increments over the next 2 years.

So this project, which is being carried out by Prof. Ralph Turner at UCLA, is in its third year. They have done a number of things in their analysis. They have conducted a survey of the Los Angeles County area, in trying to get some understanding as to how the Palmdale bulge was perceived, the actions that individual citizens are taking in preparation for a possible earthquake, and they also have done a comprehensive analysis of the mass media in the Los Angeles area looking at how the newspapers report on the events surrounding the Palmdale bulge, looking at newspapers accounts, the way the radio and TV media have been treating this emergent problem. They have also attempted to get some understanding as to what the public sector is doing—local government and State government—with regard to the Palmdale bulge.

The project team is in the final stage of analysis of the great deal of data that they have accumulated. They have already written three interim reports, which we could make available to you.

They expect to complete their final report in the next several months. They have not waited until the final report, however, to disseminate the information. They have engaged in very significant dissemination utilization activities over the past 3-year period—talking to people at the Seismic Safety Commission, talking to people in the Los Angeles mayor's Earthquake Prediction Task Force, and so on.

We expect them to come out with a report which will provide some very useful recommendations to mission agencies like the California Office of Emergency Services and FEMA.

Mr. **Brown**. That was going to be my next question—whether the structure of the research and in the grant agreement provided for a follow-on to the analysis in the form of recommendations of policy options in the category of different activities that might be important?

Dr. **Anderson**. Very definely. Just last week, we made an arrangement for the principal investigator, Ralph Turner, to come to Washington and share some of his findings with relevant mission organizations.

One of the groups of people that he spent some time talking to were people at the FEMA staff.

Dr. **Sanderson**. Mr. Brown, I don't want to sound overly optimistic. As you point out—we do have a very modest budget in the societal response area—but we can also turn to another example I cited in my written testimony—the work with the Association of Bay Area Governments to support an interdisciplinary team looking at the liability of governments for earthquake hazards reduction activity.

I mentioned this additional grant because as I came in this morning I happened to hear the topic of liability under discussion. This issue was one of the concerns that FEMA had in moving into the earthquake mitigation area. The grant to the associations resulted in recommendations for legislation in California, which are currently working their way through the State political system.

Mr. **Brown**. Yes; I think that type of research, the ABAG grant, as well as the UCLA one, which, if it were contemplated in the enactment of Federal legislation can lead to specific action in the form of changes in the laws, codes, organizations, and so forth, then it is fulfilling the purpose of the act to establish a situation in which the public is more adequately protected in the event of a catastrophe of this sort.

The Palmdale bulge and the research that has been described with regard to the public reaction to it is rather an interesting phenomenon, but I guess it is what you would call it a long-wave phenomenon.

What if you get a prediction that next week there is going to be an earthquake? I am a little concerned that we would be able to, again, fully utilize that opportunity or a systematic analysis of public response and so forth. It bothers me that you, in the nature of your organization, have a rather long turn-around time. Is it conceivable that you might do sort of like what the Geological Survey does; instrument an area that we think there might be an earthquake in the next 5 years—not only be prepared with a contingency mode of some sort to analyze the policies, social and other aspects of that physical event?

Dr. **Sanderson**. Mr. Brown, you brought up an interesting point. I don't know whether we have established baseline data in a number of these seismically at-risk areas. However, we do have in place two organizations, the Earthquake Engineering Research Institute in California and with the National Academy of Sciences, extending awards to put disaster teams into the area within some 24 hours of the time that disaster strikes.

I can't claim we were thoughtful enough to have put those in place with the anticipation of responding to a warning, but the typical roster with the California branch consists of some 200 scientists, of which some are economists and other types of social scientists.

From this roster at any given time, a disaster team is assembled to go into the area on a moment's notice. The team is put together with an eye toward a particular type of anticipated research that will be needed.

The concept is something like the disaster teams which the FAA puts into the field in event of an airplane crash.

One of the things which I hope to do over the next year is to look at the composition and strategy by which each of those teams have been put together, because we have been relying very heavily on the Academy and on the EERI group to put the proper balance of teams into place. I will be in a better position later to comment on the particular balance. However, we do have a mechanism to get people into an area where there is a seismically interesting event, and I would like to extend that to include a warning within a 24-hour period.

Mr. **Brown**. I think what you have done is highly commendable. I was not aware that you were that well prepared. I am not sure at this point, since we have never actually utilized the formal mechanism of issuing a prediction and warning to whether we need to be prepared for that contingency, but I think it is quite likely that, within the next year or two, we perhaps should be prepared for it; and, given the leadtime that is required for accomplishing some of these things, it might be that is a reasonable thing to anticipate.

Dr. **Sanderson**. I think that is a very good suggestion and your concept of beginning to develop more baseline data in some of these areas so that we have some reference point for change is also a useful idea.

Mr. **Brown**. I have a lot of good ideas. [Laughter.]

Dr. **Ziman**. I have a few questions. I hate to slight the fundamental research people. I will try to come back to them in a minute.

Dr. Sanderson, one of the things that has been noted in the NSF budget over the past years is that there is a question of transferring this program out of NSF and into other agencies. I assume that, perhaps, it would be FEMA if we are to talk about other agencies.

If this were to happen, what agency would you expect it to go to, first of all, and would you propose to do this; and, if so, do you have a time in mind to do this sort of thing?

This is a three or four part question here.

Are you taking any steps right now to think about this?

Dr. **Sanderson**. I assume you are asking specifically with regard to the earthquake program?

Dr. **Ziman**. Yes.

Dr. **Sanderson**. At present we have no plans under discussion for the transfer of the earthquake research activities out of the National Science Foundation.

Our goal in getting into any of these focused research programs, one that has been discussed extensively with the National Science Board, is essentially to work ourselves out of business, and I think we have done that in a number of areas. For example, the Congress in passing the Natural Native Latex Act established major development and implementation programs in the Departments of Commerce and Agriculture for the implementation of guayule program for natural rubber in the United States.

That I believe provides us the opportunity to transfer our substantial research in guayule over to the Department of Agriculture and Commerce.

Earlier, we had histories of transferring a number of programs such as fire research and energy research. While our goal is to get out of any of these problem focused areas in a reasonable time, it is also our intent to get out in an effective fashion. At present, we do not anticipate transferring any substantial portion of the earthquake program into any other agency. Clearly, FEMA, as it evolves over time, may become a logical agency for part or all of the activities, although my understanding is that FEMA plans to remain primarily in a coordination role, plus an implementation role, and leave the research to other agencies.

I think it is important to note that the National Science Foundation's strongest asset may not be its particular projects as far as

best copy available

the Government's benefit, but its particular style in supporting research, which is very heavily dependent on interaction with the research community. A style which is oriented to draw out their best ideas; and, particularly in the fundamental areas of research, whether basic or applied, we can bring some unique attributes that many other agencies cannot.

As one moves more toward implementation activities, some of the more directed capabilities of other agencies may become more appropriate and, at that time, it may be reasonable to think about moving.

Dr. ZIMAN. In the past you have supported some of the National Bureau of Standards research. Will you be doing any of that in fiscal year 1981? Do you have any past money or grant money for that?

Dr. SANDERSON. We have provided substantial support for the Bureau of Standards. Indeed, this year, I think, is the first year in which they have shown any funds for this type of research activity in their budget or direct funding.

I anticipate that we will continue to work closely together. While, again, it is a question of competitive use of our resources, we certainly have not contemplated any turnoff of the activities going on there or are a turnoff of our support; but, as I say, it depends in part upon their budget—the particular need for their skills and assets as the program evolves over the next year. We are currently working very closely with them now in a number of areas, including the development of the ATC-3 codes.

Dr. ZIMAN. One of the questions that was raised, at least, 2 years ago in the Appropriations Committee was the question of whether any other agencies were doing research in this area—this area being policy research aspects—whether there was duplicity of research? Could you just speak directly to that question for the record.

Dr. SANDERSON. Yes; duplication of research is a very dirty word in Washington.

I don't think there is any duplication of research going on between what we are supporting and what other agencies are supporting. Certainly, FEMA will begin to, as I understand, develop some research program targeted more towards the implementation dealing with a broad range of disasters.

I have an interagency advisory committee which has representatives from almost every Federal agency supporting research, including HUD, Department of Agriculture, Department of Transportation, and we coordinate these activites. I would say there is no duplication. Indeed, our research is generally more fundamental. A case in point is a project that is currently under negotiation between HUD and the National Science Foundation.

Very clearly there is a fairly sharp demarcation of NSF role in the type of longer range research we support and shorter range research that the mission agencies feel is appropriate to their mission.

We are, obviously, always encouraging people to do more basic research.

Mr. BROWN. I don't want to quarrel with you learned gentlemen who understand the English language much better than I do, but I think duplicity is something that Congressmen engage in. [Laughter.]

Mr. BROWN [continuing]. Duplication is what bureaucrats engage in. [Laughter.]

Dr. **Sanderson**. Six months ago I couldn't even spell it. [Laughter.]

Mr. **Brown**. Tony, do you have questions?

Mr. **Scoville**. Yes, Mr. Chairman, thank you.

Dr. Sanderson, I note with interest on page 8 of your testimony that you say—

> Our experience has shown that a problem-focused research activity without effective participation by the community that will utilize the results of the research is not likely to have a substantial, positive impact.

I guess I'm very interested in this because it seems to me that you are exactly echoing the Chairman's model that he was discussing earlier with the USGS in connection with the lay observers.

I guess my question to you would be has the foundation attempted to or does it anticipate attempting to develop guidelines which might be useful to other agencies when they were doing research, such as the USGS, in which they could communicate lessons learned, sort of make citizen participation in research programs most effective; and, if you have or anticipate trying to develop such guidelines, or just general advisory work, have you or will you—I assume you will communicate these to other agencies. Do you see what I am getting at? In other words, it seems there must be some useful lessons here to be learned that could be well transmitted and it may be worthwhile to put them in a form that other agencies could use in developing research programs and things like that.

Dr. **Sanderson**. The direct public communication of research and technology has been primarily the responsibility of our science education program—the public understanding of science.

I think Dr. Rutherford would be a good person to respond to questions about public communication.

In the intergovernmental communication area and in the communication to the research community, and to practicing engineers—a substantial part of that activity does fall under my area of responsibility.

Mr. **Scoville**. Dr. Sanderson, you may not have been here when the Chairman was having discussion with the previous witness. He was talking about the problem of lay participation in actually carrying out research. He suggested that, in many cases by having community participation in, say, taking seismic observations or whatever it may be, the community who eventually is going to have to learn to live with the results of any predictions would be more aware of both the limitations, as well as become more, essentially, supportive of this type of scientific research as a result of the fact of becoming actively involved in it. You see, they would acquire an interest in ths subject.

What it seemed to me your statement was reflecting is that, in fact, your findings in this area of problem-focused research activity would support the Chairman's model.

In other words, somehow involving the public in the actual process of research, you tend to enhance the utilization of the results of the research. What I was wondering is has your directorate or has anybody for that matter attempted to try to put these lessons of how you get effective participation in the research into some sort of form that could be transmitted as guidelines to other agencies, which I think is a little bit different than, perhaps, what you thought it was?

Dr. **Sanderson**. I am afraid we have not responded with a particular set of guidelines or structures in this area.

Dr. **Ziman**. Do you think it would be useful?

Dr. **Sanderson**. I think it would be useful. There are a couple of things which are at least tangentially relevant to this, particularly in the area of involvement of State and local representatives in the research area.

We have currently in production a small film describing some of the intergovernmental activities of the National Science Foundation. One of the topic areas which was selected for this document was the area of earthquake research and the way the earthquake research program relates to the needs of State and local officials.

Also ,we have a project which I described very briefly in some earlier hearings looking at some problems of the Federal research agenda in responding to needs at the State and local level. We have gone through a number of activities. A key body in that project is an interagency steering group comprised of representatives from some 12 or 13 agencies that are highly oriented toward the civilian sector—HUD, DOT, et cetera.

We have been looking at ways the Federal Government can be responsive to research needs at the State and local level. A final report is in rough draft form and will be reviewed within the next month. This will represent a collective effort led by NSF of these dozen or so agencies to understand how the Federal scientific structure can respond.

To test the system, we used a number of case studies. We picked five test cases in which Governors, State legislators, or city officials approached Washington with particular problems—such as radiation tailings, and the transportation of hazardous materials—and used those as tests to see exactly what could happen in the Federal research establishment. An analysis of each of those tests will be included as part of the report which will be available sometime later this year.

Mr. **Scoville**. Just a couple more questions.

Dr. **Senich**. Mr. Scoville?

Mr. **Scoville**. Yes, surely.

Dr. **Senich**. I just want to make one point. We just recently have given a grant to the Academy for Contemporary Problems. In this area we are working with the PI in a effort to make sure that our research—and I am going now to say that the State and local governments represent lay people, as Mr. Brown suggests are involved in our program. In this case, we are reaching out and trying to disseminate information from the research community through this grant to the State and local governments.

By this means or by other means, we should be able to provide some background for other agencies—like the mission agency on the implementation side and the dissemination at some point—to move these ideas from the idea of a concept of reaching to the State and local governments—that dissemination effort—and then try to put it into FEMA for the actual implementation.

So we are trying different mechanisms to get the information out to the community that can use that data.

Mr. **Scoville**. Dr. Johnson or perhaps Dr. Brett, because, Dr. Johnson, you have just recently arrived on the scene, can you tell me—and maybe you will want to supply a list for the record—what basic geological research are you doing now as a result of the mandate of the Earthquake Hazard Reduction Act that you would not have been doing without the act?

In other words, what I would like to know, I guess, is to what extent there is generally new initiatives in research that wouldn't have gone before and to what extent are we, perhaps, merely relabeling the material? Obviously, Congress has given special attention to this area.

I would be interested to know how much that special mandate and emphasis has in fact developed a stronger program as a result of this.

You may want to answer that for the record.

Dr. BRETT. I think I can answer that briefly now, As I stated in my testimony, we have always regarded the seismology subfield as a very important part of the program. It has always been more than 50 percent of the program. It still is more than 50 percent of the program. As you know, most of the divisions at NSF respond to proposal pressure from the outside community. We do not direct research. We do not give out contracts from the division. We give grants.

I think the effect is indirect in that clearly the community through the exposure to the Newmark-Stever report and the act itself—is concerned about the problem, and they have, therefore, rallied in response to that problem. I think, therefore, we have had considerably more proposal pressure in these areas and more interest and good scientists going into the area, but it is not a first-order effect at all.

Mr. SCOVILLE. So in other words what you are saying is that the new mandate, essentially, has just stimulated greater proposal pressure rather than your letting the new proposals or any new research flow from that, rather than out of any specific directive coming from the foundation?

Dr. BRETT. Exactly. I think the additional budget of USGS has stimulated interesting research results which have stimulated the academic community which was made them come to us.

Mr. SCOVILLE. This is sort of a related question to this. It is dealing with NSF's—the question of the leadership role of the foundation and whether or not it should take the initiatives or whether it should respond to pressures from the outside.

The one thing that a little bit bothers me and, I guess, this question may almost go more to Dr. Sanderson in regard to the funding level, would almost appear that the foundation, rather than proposing the strongest program, is attempting to anticipate congressional budget cuts. That sort of a little bit worries me.

I notice that, following the drastic cut in fiscal year 1979 in societal response, NFS's request in the societal response dropped in fiscal year 1980 from $4.8 million to $1 million. In other words, it is just a lag of a year.

There is, also, I notice in the engineering, if you look at the track record of the engineering requests, you start out climbing all the way up to fiscal year 1979 to a peak of $21.6 million, but then you drop back in fiscal year 1980 to $17.3 million. At the same time, this seems to be following a pattern of, essentially, very marginal increases in the actual appropriations that are granted here.

I just wonder what your response is. Do you feel at any level of the executive branch that there is—because obviously your request represents a synthesis of agreements at the directorate level, at the foundation's level, and at OMB—has there been a sort of anticipation, of well, Congress cut us this time; therefore, why go in for the request that we think is the strongest possible program. Could you perhaps respond to that.

Dr. **Sanderson**. I will try.

First, I think it is very clear that, anytime you get burned, you tend to get a little more cautious and, given the fact that in any given year, you are only going to go in for a certain size budget, you would much rather ask for it where you are fairly certain that you will get it. That is a normal reaction.

I think more important is the point I emphasized earlier on in my testimony, that, perhaps, a smaller budget, but with a great deal of continuity, over the long term, will produce a more effective and higher quality research effort than a budget that is high one year and sharply down the next. This pattern would be disruptive to the community, and I think there is a real feeling that, certainly in the social science area, it is going to take some time to rebuild confidence in the program, as a program.

Mr. **Scoville**. What bothers me—and I fully appreciate the need for continuity of funding, which is particularly true in something like the earthquake area where you have to have long baseline observations and things like this. What bothers me is, by attempting to anticipate a possible adverse congressional reaction, it seems to me you are almost telling the research community, look, we are not going to go to bat for you as hard as we possibly can. You ought to be coming in, it seems to me, with the program that you think is the best. Let Congress, in their wisdom, decide that this is the way the country does it or does not want to do it. It seems to me that is the function of Congress to do that.

If I were a scientist out there, I would be more worried about the fact that the Foundation was not going to bat for the strongest program possible. If Congress decides to not request it, it seems to me that is what they should do.

Dr. **Sanderson**. Dr. Johnson would also like to comment, but I would like to emphasize that my habit is to go to bat for all of my programs as hard as I can.

One of the important factors, remember, is that in the fiscal year 1981 budget, which we are discussing, the Foundation is undertaking a number of very significant initiatives relative to national priorities. In addition to earthquake research there are significant increases in the area of innovation, industry-related programs and a significant initiative in the area of ocean-margin drilling.

As always, there is the problem of trading off priorities, opportunities, and needs in any given budget year against the resources. The overall constraint is obvious. The inflation rate is running at 18 percent now.

Mr. **Scoville**. I think you said there is a tradeoff between the ocean-margin drilling program and the priorities——

Dr. **Sanderson**. No, I did not say that. I said there is a tradeoff among all the initiatives which we have.

Mr. **Scoville**. I wanted it clarified because that has been a concern, I know.

Mr. Chairman, thank you very much, sir.

Dr. Johnson, do you want to comment?

Dr. **Johnson**. Could I make just a short statement relative to that question? It seems to me that, when something is taken out of the budget in the appropriation process, that is an indication of the intent of Congress, and we must take account of this in the following year.

It would be unrealistic, I think, for us to ignore that message in its entirety. I think the real question is to what extent should we try to temper it, if we feel that it was not really the best action that might have been taken. In that case, we ought to try to start working back to the requested level, but ordinarily I think that we have to take a cut as a clear indication from Congress that we need to pull back in that area.

In further comment about encouraging selected activities, I agree with what Dr. Brett said, but there is another mechanism that can be used by the Science Foundation. If we are instructed to spend additional money in a given area, we can put out an important notice which, in turn, stimulates additional proposals. So we are not quite as dependent upon a passive mode of response as the earlier remarks indicate. We can stimulate additional response in an area where we are instructed to do so.

In the case of the ocean-margin drilling, of course, the budget request is well isolated from the rest of our budgetary requests this year, but it is also the case that we have to be very discriminating about what we will fight strongly for when there is a limitation on the total budget that we can expect. So at the management level in the foundation, one can't give all support one might like to, to programs which are not likely to survive.

Mr. **Scoville**. Thank you very much, Mr. Chairman.

Mr. **Brown**. Gentlemen, I am not going to continue any longer this morning. We have one more panel, which I am sure wants to get away before lunch, also.

I want to thank you for clarifying the situation in this area. I will be glad to excuse you at this time.

Dr. **Sanderson**. Thank you, Mr. Chairman.

Mr. **Brown**. We continue with the distinguished panel from the Bureau of Standards—Dr. John Lyons, Director, National Engineering Laboratory; Dr. Richard Wright, Director, Center for Building Technology; and Dr. Fred Clarke, Director, Center for Fire Research.

We would like, in the time that we have available, to explore the work which you gentlemen are doing at the Bureau in connection with the programs related to both earthquake and fires.

We are trying to acquire a better comprehension of how these complex multiagency programs are operating and whether there is anything we can do to help them to operate better.

Do you want to proceed, Dr. Lyons.

Dr. **Lyons**. Thank you, Mr. Chairman. I am pleased to have Drs. Wright and Clarke with me. I have a formal statement, as does Dr. Clarke. With your permission, we will insert both of those into the written proceedings.

Mr. **Brown**. Without objection, they will be inserted.

## STATEMENT OF JOHN W. LYONS, DIRECTOR, NATIONAL ENGINEERING LABORATORY, NATIONAL BUREAU OF STANDARDS

Dr. LYONS. Let me summarize briefly the activities of these two areas for the subcommittee and then enter into discussion on some of those points.

The Bureau of Standards is playing a key role in research and measurement activities in standardization and code revisions in both fire safety and earthquake disaster mitigation. I will say a word or two about each.

First, the fire program. Under the Federal Fire Prevention and Control Act of 1974, there were established two separate entities, that entity now known as the U.S. Fire Administration and the Fire Research Center at NBS. Appropriations were authorized for each.

The Bureau's Center for Fire Research was charged by that Act with conducting both basic and applied research on both fire phenomena and the effects of fire on its victims, with emphasis on firefighters, but including all victims.

That research is detailed in the act and it covers a variety of disciplines ranging from physics, to chemistry, toxicology and, indeed, in some cases, to psychology, for example, with respect to the motivation of arsonists.

In fiscal year 1980 the week was funded in two parts for the first time; $1.1 million was appropriated to the Secretary of Commerce for center activities, and $3.9 million was appropriated to FEMA for the Fire Administration for passthrough at the Center for Fire Research at the Bureau.

For fiscal year 1981, the President has requested $1.253 million indirect appropriations to the Secretary of Commerce for Center activities and $4.005 million to FEMA for the Fire Administration to passthrough to the Department for Center activities. H.R. 6326, the administration authorization of appropriations bill for NBS activities contains the authorization for the $1.253 million and H.R. 6662, an Administration authorization bill for FEMA fire activities contains the $4.005 million.

The direct funds, that is the smaller of the two numbers, will be used to operate the center and to maintain its basic research capability. The passthrough FEMA funds will be used for programs defined jointly between the Department of Commerce and FEMA.

The Center for Fire Research has operated for a number of years under a long-range plan, first developed in the year following the passage of the Federal Fire Prevention and Control Act.

We developed the plan with a bottoms-up style from the management team at the Bureau, and we reviewed that planning in detail with the Administrator, not only after it was written, but during the process. The first time we did that, we actually secured formal approval; that is, I sent it, when I was Director of the Center, up through my Institute to the Director of the Bureau, to the Assistant Secretary, over to the Fire Administrator, and we secured approval at every step.

We have not been as formal about that since that first time.

Mr. BROWN. You probably learned how long it took.

[Laughter.]

Dr. Lyons. We found that a very useful exercise. We first did this somewhat before the Fire Administration got up to its full strength. Subsequently, the Fire Administration has developed its own plan. I believe that has been discussed earlier this week, and the Bureau's plan for activities in the Center is made a part of the Fire Administration's plans.

We use this document. We have found it to be a fairly effective operating tool, as well as a conceptual and strategic document.

I want to give you one example of operational use; namely, how the long-range planning influences our use of grants in the Fire Research Center. That is the same program that Dr. Sanderson referred to a moment ago. He said it was transferred to the Bureau.

We first lay out the work that we feel is of the top priority in the plan and then, having seen the various pieces, we are able to make a judgment on each piece as to whether it is better done at the Bureau or whether there is a compelling reason to do it on grants.

Having made the decision that we are going to do a certain portion, let us say toxicology, for example, which is difficult to do except via grants, we will receive and review proposals, much as NSF does. Some of the review is less formal, but we use the same general principles to make the awards.

Then we turn over the responsibility for an individual grant once it has been awarded to the pertinent in-house group. We do have a toxicology group at the Bureau which worries about the standardization aspect. Then that group is concerned with monitoring and guiding the grantees.

Dr. Clarke and I have always felt that the work of grantees in these various program elements are just as much a part of the Bureau's program and just as much a part of the responsibility of that first-line supervisor as the in-house work. That is fairly easy to do because the grants represent about one-fourth of the total budget of the Center, so oversight is not overly distracting.

We have attached to my formal statement a full list of these grants for the fiscal years 1977 through 1979, if you would like to review this aspect of our work.

In addition to the program's appropriations to NBS and to FEMA, there is another agency program that is rather substantial. In fiscal year 1980, we estimate we will receive reimbursements from a variety of agencies, to the extent of about $3.5 million. So the total budget for the Center from all sources is of the order of $8.5 million.

Because we do fire research for so many agencies, because we operate a grants program at the universities and because we have an industrial research associate program in the Fire Center that is quite effective and has had as many as a dozen senior professionals from industry, I think it is a fair statement to say that the Bureau of Standards is indeed the central fire laboratory for the Nation.

In my testimony on February 12, I mentioned that I thought the key to the relationship between the Center for Fire Research and Fire Administration was the personal interactions and not pieces of paper. I believe that very strongly. I think our success in the Center, with the Fire Administration, has been almost entirely due to effective personal relationships between the two top managers.

In this connection, I am pleased to note that Dr. Clarke will shortly assume additional duties and begin to serve as a science adviser to the Fire Administrator. That is, he won't stop being Director of the Center for Fire Research, but in addition he will serve as science adviser to the Fire Administrator.

Mr. Brown. I think Mr. Vickery mentioned that and was looking forward to the opportunity to work in that mode with Dr. Clarke.

Dr. Lyons. We think that will cement the relationship further and that is the way, in fact, to make the relationship work, so that, when the Federal Fire Prevention and Control Act says we shall consult with the Administrator, I think you can see it is more than that—quite a bit more.

Incidentally, Mr. Chairman, I would like before I move to "earthquakes" simply to acknowledge our appreciation for the support expressed, I think yesterday, by various outside organizations for the work at the Center. We appreciate that support very much.

The activities of the Center were discussed in the formal statement and, also, somewhat in my earlier statement before the committee on the 12th of February.

Let me now turn to the earthquake program. It is not as clear, not as gelled, if you will, as the fire program. Our Center for Building Technology, which in many respects is the Nation's central building research facility, has worked in the earthquake area for a number of years. The work of the Center for Building Technology was discussed in my earlier testimony as is discussed, again, in my formal statement today. One of the Center's thrusts is focused on building safety—safety in construction and, to some extent, safety in the use of buildings.

Within that general area, we have had concern for and have had programs in earthquake disaster mitigation area as well as wind disaster mitigation during most of the seventies.

In the earthquake area, we have been concerned with methods for evaluating the safety of structures. We are concerned with design criteria and standards. We have done a number of significant post-disaster investigations. We have a disaster team in earthquakes. We have looked into California earthquakes, Central America earthquakes, and those in Japan and one in Romania.

We visit earthquake sites when we think there is something of research interest that can be learned. Obviously, we can't go to all earthquake sites, but we have gone to a number of them—the more significant ones.

In 1972, in concert with the National Science Foundation, the Department of Housing and Urban Development, and the Office of Emergency Preparedness, we planned a cooperative program on building practices for disaster mitigation.

Subsequent to that, NBS and NSF conducted a 3-year program to develop updated seismic provisions for building codes, which were mentioned by Dr. Sanderson and, also, discussed by Mr. Macy in his earlier testimony.

This was done, as you know, with the Applied Technology Council in California and was distributed in 1978 for comments by all interested parties.

The implementation plan developed by the President pursuant to the Earthquake Hazards Reduction Act in 1977 gives NBS a two part role: First, to develop, test, and improve model seismic design and construction provisions suitable for incorporation in local codes, standards, and practices; and, second, to perform research on performance criteria and supporting measurement technology.

That area was designated by the President as an important part of his earthquake plan.

The funding story here is that NBS reprogramed $271,000 to add to $154,000 we already had to bring the total to $425,000. That is the level that is in the President's budget for fiscal year 1981.

A couple of organizational comments—the Interagency Committee on Seismic Safety and Construction is a group which is focusing on part of the challenge of the Earthquake Act.

Our role there is to draft and recommend to the full committee proposed standards for construction. We will submit our recommendations in May of this year for the committee's deliberations.

There is an additional mechanism created by the Federal parties involved—the Building Seismic Safety Council, comprising members from the building community and State and local officials. That group is currently refining the tentative provisions that I mentioned earlier developed with the ATC. There is a continuing activity necessary there.

That completes my brief summary, Mr. Chairman. I would be pleased to take questions.

[The prepared statements of Dr. Lyons and Dr. Clarke follow:]

U.S. DEPARTMENT OF COMMERCE
WASHINGTON, D.C. 20234
STATEMENT OF
JOHN W. LYONS, DIRECTOR
NATIONAL ENGINEERING LABORATORY
NATIONAL BUREAU OF STANDARDS
BEFORE THE
HOUSE COMMITTEE ON SCIENCE AND TECHNOLOGY
SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY
ON THE FIRE RESEARCH AND EARTHQUAKE HAZARD
REDUCTION ACTIVITIES OF THE
NATIONAL BUREAU OF STANDARDS

FEBRUARY 27, 1980

Introduction

Mr. Chairman and Members of the Subcommittee: It is a pleasure for me to appear before you in these hearings on the funding reauthorizations for the Earthquake Hazards Reduction Act of 1977 and the Federal Fire Prevention Control Act of 1974. I shall not describe the National Engineering Laboratory's overall programs but shall direct my comments to NBS' work in fire sciences and earthquake engineering and our relationship with the Federal Emergency Management Agency (FEMA).

Since I served as the first Director of the Center for Fire Research (CFR) at NBS, I can give you a first-hand perspective on the Center and its programs. First, I shall describe the authorizing legislation which created the Center and authorized certain research programs. Then, I shall discuss the Center's budget allocations including the money allotted for the university grant program. Finally, I shall explain our long range planning process and our current research programs.

The other section of my testimony addresses NEL's earthquake hazards reduction program which I know is of prime interest to you, Mr. Chairman. As background, I shall discuss our early work on earthquake hazard reduction, including a description of our analytical and laboratory research, post-disaster investigations, and our development of design criteria for buildings. Then, I shall focus on the Earthquake Hazards Reduction Act of 1977, the President's Plan under that Act, and our activities to support the total earthquake hazards reduction program.

## Fire Research

The Center for Fire Research was established by the Federal Fire Prevention and Control Act of 1974. That same Act also established in the Department of Commerce the United States Fire Administration (USFA), an operating unit of FEMA since 1979. The Center, in consultation with the USFA, is charged with performing and supporting research to provide scientific and technical knowledge applicable to fire's prevention and control.

The Fire Act authorizes the Center to conduct a research program to improve understanding of the fundamental processes underlying all aspects of fire, including its physics and chemistry; the dynamics of flame ignition, spread and extinguishment; the composition of combustion products; the early stages of fire in buildings; an understanding of the behavior of fires in structures as governed by their contents; design concepts for providing increased fire safety consistent with habitability, comfort and human impact, and improved arson detection. The Center is also authorized to carry out research into the biological, physiological and psychological factors affecting fire victims, and those factors affecting the performance of individual members of the fire service. Research in this area can include the biological and physiological effects of toxic fire gases; the trauma and other hazards resulting from fire; the development of reliable tests for determining the cause of fire death; improved first aid methods for fire victims; conditions of stress on firefighters; and psychological characteristics of arsonists.

The Center, through NBS, receives an authorization for appropriations separate from that of the USFA. In prior years when the USFA and the Center were both in the Department of Commerce (DoC), the Center's appropriation appeared as a single line item in the Fire Administration's section of the DoC budget. This line item included funds to support the fire research grants program. Beginning in FY 80, with the transfer of the USFA to FEMA, the Center's appropriations were split.

Currently, we are receiving about $1.1 million in direct appropriations to the National Bureau of Standards and $3.9 million in funds to the Center through FEMA. The President's FY 81 Budget includes $1.253 million for the Center for Fire Research and additional funds of $4.005 million to be transferred to the Center from FEMA. Authorization for the direct NBS appropriations were requested in the NBS Authorization Act, H.R. 6326, while the pass-through funds for the Center were requested on February 22, 1980, in the Administration's bill for reauthorizing the Fire Act.

The NBS has been directed to use its money for administration, operation of the Center, and maintenance of our basic research capabilities in fire sciences. The Center's pass-through funds are to be used for a mutually agreed-upon program of fire research to meet the Center's responsibilities under the Federal Fire Prevention and Control Act of 1974.

In its 1979 oversight report, this Committee concurred with this split budget "to the extent that the requested division of appropriation insures a strong consultative relationship between the Center for Fire Research and the U.S. Fire Administration." I would like to comment further on this consultative relationship.

In 1976, the Center prepared its first five year plan, "Attacking the Fire Problem." A copy of that plan was published in this Committee's hearings of that year. Since then updated editions of the Plan have been published regularly. It is during the planning process for each Plan that priorities and program content are established and consultation with the Administrator of the USFA first occurs. These plans are reviewed and concurred with by the Administrator and are included, either directly or by reference, in the USFA's own planning documents.

In 1975, this Committee directed that part of the fire research effort of the National Science Foundation, known as Research Applied to National Needs Program, be transferred to the Center for Fire Research. This university grant program formed the nucleus of what is now the extramural portion of the Center's research. As was the case when the program was part of NSF, most of the work continues to be in fundamental science combustion physics and chemistry, fluid mechanics, toxicology and applied mathematics. In FY 80, these grants will receive $2 million of the $3.9 million appropriated to the USFA and transferred to NBS.

The Center's work is laid out in its long range plan. Each area is reviewed by management and portions suitable for awarding grants are identified. Proposals are reviewed by a formal process. Once awarded, monitoring and oversight of the grant is assigned to one of the Center's in-house technical groups; the work is considered part of the work of that group. In some cases, the grant is an extension and amplification of in-house work. An example is modeling of fire growth in an enclosure. Where the work cannot be done readily at NBS, as is the case in studying the biological effects of fire gases, NBS relies on the university grant program to carry out the Center's responsibilities in toxicology, physiology and psychology under the fire legislation. However, the development of standardized test methods and proposed code changes, based on work done by grantees, is handled by in-house staff. The manner in which the grants work is interwoven with in-house work has allowed us to administer the grants with just one professional and one assistant. For your information, I have attached a list of the grants funded during the period FY 77-79.

In addition to the research done on funds appropriated directly to USFA or NBS, the Center conducts an extensive program for other Federal agencies on a reimbursable basis. In FY 80, this will amount to about $3.5 million. This work, and the relationships and ancillary information it provides, gives the Center a unique perspective on most of the fire research carried out in the Federal Government. NBS is, in fact, the Federal Government's central fire research laboratory. Because of its extensive program of grants to universities and the many industrial research associates we have had over the years, the NBS Center for Fire Research is also the Nation's central fire research facility.

It is part of the USFA Administrator's responsibility to provide overall coordination and assessment for fire research and technology throughout the Government. He has asked for the help of the Center for Fire Research in carrying out these duties. In the near future, Dr. Frederic Clarke, Director of the Center for Fire Research, will assume the additional post of Science Advisor to the USFA. In this new capacity, Dr. Clarke will be responsible for keeping the Administrator abreast of scientific developments, whether at NBS or elsewhere, and for assisting the Administrator in his efforts to assess and coordinate Federal fire technology efforts. This arrangement is a partial response to the Committee's urging that national fire prevention control and data needs be identified as part of a coordinated interagency planning program.

Mr. Chairman, on February 12, 1980, I gave you a broad overview of the fire program in the NBS authorization hearings. In his prepared testimony Dr. Clarke addressed some of the Center's technical concerns. Since you are familiar with much of our work, I will describe only a few areas of fire work. Consequently, I would like to insert in the record, with your permission, the portions of my earlier testimony dealing with the Fire Science and Engineering subactivity.

The Center's research program focuses on selected areas where improved information, test methods, and other ways of measuring and controlling fire risk can reduce fire losses. Any such research program must give the highest priority to the residential fire problem. I would like to point out that building codes do not treat residential occupancies, especially one- or two-family dwellings, with anything like the same rigor applied commercial occupancies. Further, it is unlikely that local building code officials will find it feasible to try to control the furnishings and other details of the average family home. Therefore, if we are serious about reducing residential fire losses, new technology must be delivered in other ways. Some of these are improved materials from manufacturers, safer products developed under the influence of voluntary product standards in the private sector and mandatory standards from government. These standards will control fire safety at the point of sale for furnishings and building materials.

In addition, a vigorous public education effort is needed. Here the Center relies heavily on the USFA. We have already had some signal successes such as:

- NBS' contribution to the technical information behind the USFA's smoke detector education campaign;
- NBS' production, with help from the USFA's Planning and Education Office, of a film entitled, "Flashover; Point of No Return," which is now being distributed as a training aid to hospitals and nursing homes staff;
- Use by USFA's Planning and Education Office of the NBS developed Fire Safety Evaluation System for hospitals and nursing homes in a training package for State and local authorities.

We look forward to more such instances as these in the future, as evidence of the maturing partnership between the U.S. Fire Administration and the Center for Fire Research.

Earthquake Activities

NBS has conducted earthquake-related research for many years. This research is an integral part of our building research program. The major thrusts of our earthquake work include: (1) safety evaluation of existing buildings, (2) improved design criteria and standards, (3) post disaster investigations, and (4) more reliable measures of effects of natural forces on buildings. The work involves interdisciplinary analytical, laboratory and field research conducted in cooperation with other government agencies, practicing engineers and architects, professional organizations, trade associations, building owners, product manufacturers, standards and regulatory organizations, and university researchers. This close liaison assists us in identifying and assigning priorities to research problems in earthquake engineering.

Earthquake research at NBS provides basic knowledge for the development of engineering standards and related measurements. A project carried out for the Veterans Administration (VA) serves as an example. The objective of the work was to establish procedures for evaluating the ultimate strength of unreinforced masonry walls in existing buildings to determine the seismic resistance of these buildings. We compiled existing test data defining the strength of typical types of masonry, developed test methods (destructive and non-destructive) for determining strength and stiffness properties of walls, and developed recommended procedures for assigning strength values to walls and deriving the overall structural resistance as a function of wall resistance. Results from this work have been included in the VA's design requirements for evaluating VA hospitals located in high seismic risk areas.

In a related activity sponsored by the former Defense Civil Preparedness Agency, NBS developed a methodology for surveying and evaluating existing buildings to determine risks of damage caused by high winds and earthquakes and to identify how those buildings can be strengthened if the risks are deemed excessive. The methodology allows responsible authorities to define the safe levels of risks in accord with local conditions including natural, economic, and social factors. The General Services Administration used this research to develop survey procedures for evaluating buildings in response to section 401 of P.L. 93-288, the Disaster Relief Act of 1974.

Post-disaster investigations are an integral part of the NBS earthquake program. Through these investigations, NBS provides technical assistance in connection with relief and reconstruction efforts and acquires valuable field data on the performance of structures for use in developing improved building practices. In response to requests from the Congress, the Defense Civil Preparedness Agency, the Office of Emergency Preparedness and the State Department we conducted investigations following the earthquakes in: San Fernando, California in 1971; Managua, Nicaragua in 1972; Guatemala and Italy in 1976; Romania in 1977; Miyagi-ken-Oki, Japan in 1978 and the Imperial Valley in 1979.

During the San Fernando investigation, NBS staff testified before the House Committee on Public Works at a field hearing in California on February 23, 1971, and discussed the damage to the San Fernando area. NBS also worked with the Small Business Administration to develop procedures for identifying earthquake damage for use in determining eligibility for Federal loans. Following the Managua earthquake, NBS staff assisted Nicaraguan authorities in evaluating damaged buildings. An NBS study of the Nicaraguan building regulatory system was carried out under the auspices of the Organization of American States and the Agency for International Development (AID). NBS prepared recommendations on the status and development of this system and its technical bases. The Guatemala earthquake provided NBS with an opportunity to assess the performance of buildings similar in design to those in California. Following the earthquake in Italy in May 1976, NBS provided AID with technical assistance in assessing structural damage in the earthquake area and the structural engineering aspects of reconstruction. NBS staff participated on the AID team established to work with the Italian government in connection with U.S. financial assistance to the disaster victims. NBS also made recommendations to the State Department for the expenditure of U.S. funds provided to Romania for reconstruction following the 1977 earthquake.

NBS has conducted a number of analytical and laboratory research studies in the earthquake area. We have special facilities and equipment, some of which are unique. These were used to develop and implement testing procedures for cyclic loading to simulate the earthquake effects on multi-story buildings. We conducted laboratory tests to develop improved seismic design procedures for indigenous construction materials used in shelters for low-income occupants in foreign countries. The project was carried out in Peru for the AID mission in Lima. We established tentative criteria for stabilized cane reinforced adobe block construction. Prototype housing units were constructed in Peru based on this experimental work and design calculations. We also conducted research on unreinforced masonry construction which is now being extended into reinforced masonry. Some of our other laboratory research includes cyclic load resistance of mobile home tie-downs and liquefaction potential of granular soils.

In 1972, NBS worked with the National Science Foundation (NSF), the Department of Housing and Urban Development, and the Office of Emergency Preparedness, to plan a cooperative Federal program on building practices for disaster mitigation. As part of this effort, NBS conducted, with NSF support, a workshop for experts in the building community including architects and engineers, building code officials, standards writers, and planners to develop a national plan for disaster mitigation activities. This plan and the proposed recommendations to users in the building community provided an integrated approach to disaster mitigation through research and the implementation of improved building practices.

A major workshop recommendation was to update the seismic provisions of building codes, the last major revision having occurred in the 1950's. Since that time, there had been significant advances in knowledge. Based on the workshop recommendation, NBS and NSF initiated a three-year program to develop improved seismic design provisions which could be used nationwide in new buildings and in rehabilitiating existing buildings. The Applied Technology Council (ATC), a group affiliated with the Structural Engineers Association of California, served as a principal resource. Tentative provisions were completed and widely distributed in 1978. A plan for assessing and implementing the provisions was developed by NBS in consultation with broadly-based representation from the private sector and Federal agencies.

In 1977, Congress passed the Earthquake Hazards Reduction Act, P.L. 95-124, which called upon the President to establish and maintain an effective earthquake hazards reduction program. The National Bureau of Standards was cited as one of the Federal agencies to be included in this program. The President's National Earthquake Hazards Reduction Program (NEHRP) was issued June 22, 1978, and NBS was assigned the following continuing responsibilities:

- Provide technical support to the building community, including the Federal agencies involved in construction, "in continuing the development, testing, and improvement of model seismic design and construction provisions suitable for incorporation in local codes, standards (including Federal standards) and practices."
- Perform "research on performance criteria and supporting measurement technology for earthquake resistance construction."

The President identified the technical support for developing seismic design and construction provisions as a top priority.

To meet its responsibilities under the Plan, NBS reprogrammed $271,000 to augment the $154,000 already allocated to earthquake engineering. In FY 81, the NBS has requested authorization for this continued level of funding.

To develop uniform Federal standards for trial use by 1980, the President's Program called for the establishment of the Interagency Committee on Seismic Safety in Construction. This Committee, described to you in Mr. Macy's testimony of January 30, 1980 includes over 130 representatives from 17 Federal agencies, including NBS.

To develop seismic design and construction provisions suitable for use in State and local codes, standards and practices, NBS, FEMA and concerned groups of the building community met in late

1978 and early 1979 to devise mechanisms for cooperative efforts. As a result, the Building Seismic Safety Council (BSSC) was established in April 1979.

At the request of the BSSC, the National Bureau of Standards is directing technical studies of the tentative seismic design provisions developed by NBS, NSF, and ATC. With financial support from FEMA for the current year, we are working with approximately 50 organizations from throughout the U.S. to refine these tentative provisions. This is an important effort to arrive at seismic design provisions suitable for application in all areas of the U.S.

## Conclusion

The NBS considers our fire and earthquake engineering research important in the development of safer products and buildings. We plan to continue working closely with FEMA in promoting our mutual scientific goals. This concludes my formal statement. I would be pleased to answer any questions you may have.

Center for Fire Research

Fire Research Grants
FY 1977 - 1979

| Organization | Title | Amount | Year |
|---|---|---|---|
| 1. *FUNDAMENTAL FIRE SCIENCE:* | | | |
| Brown University | Flame Propagation and Extinction for Solid Fuels | $ 85,000 | 1977 |
| University of California/Berkeley | Fire Safety in Urban Housing | 261,237 | " |
| California Institute of Technology | Experiemental Study of Environment and Heat Transfer in a Room Fire | 76,045 | " |
| Georgia Institute of Technology | Investigation of the Properties of the Combustion Products Generated by Building Fires | 84,000 | " |
| Georgia Institute of Technology | Effects of Ignition Sources and Fire Retardants on Material Ignition | 50,788 | " |
| Harvard University | Home Fire Project | 282,148 | " |
| University of Massachusetts | Flame Suppression by Chemical Inhibitors | 19,000 | " |
| Notre Dame | Fire and Smoke Spread | 74,892 | " |
| Pennsylvania State University | An Investigation of Fire Induced Plumes Along a Vertical Wall | 22,917 | " |
| Princeton University | Modeling the Generation of Toxic Gases by Smoldering Combustion of Polyurethanes | 88,942 | " |
| Princeton University | An Experimental Investigation of Flame Spread Over Condensed Combustibles; Gas Phase Interactions | 71,421 | " |

| Organization | Title | Amount | Year |
|---|---|---|---|
| Southwest Research Institute | Ventilation Controlled Burn Studies | 4,950 | 1977 |
| Stevens Institute of Technology | Flammability Studies of Cellular Plastics | 5,000 | " |
| Textile Research Institute | Flammability and Combustion Behavior of Textiles | 6,000 | " |
| National Academy of Science | Support for the Committee on Fire Research - Committee on Fire Safety Aspects of Polymeric Materials | 40,000 | " |
| Pennsylvania State University | An Investigation of Fire Impingement on a Horizontal Ceiling | 21,661 | 1978 |
| Princeton University | Smoldering Combustion Studies | 89,864 | " |
| Lawrence Berkeley Laboratory | Fire Growth Experiments - Toward a Standard Room Fire test | 50,992 | " |
| University of Massachusetts | Flame Suppression by Chemical Inhibitors | 31,208 | " |
| Harvard University | Home Fire Project | 323,000 | " |
| NAS/NRC Committee on Fire Research | Support Publication of the Directory of Fire Research, 8th Edition and Fire Research Abstracts and Reviews, Vol. 18 | 16,086 | " |
| California Institute of Technology | Experimental Study of Environment and Heat Transfer Transfer in a Room Fire | 80,139 | " |
| Stanford Research Institute | The Effect of Fire Retardants on the Heat Release Rate of Building Materials | 50,635 | " |
| National Academy of Sciences | Study of Fire Safety Aspects of Polymeric Materials (Joint Effort - NAS/U.S. Coast Guard/Bur. of Mines/NBS) | 10,000 | " |
| University of Montana | Ignition and Fire Spread of Cellulosic Materials | 71,000 | " |

| Organization | Title | Amount | Year |
|---|---|---|---|
| Brunswick Corporation | Studies of Pyrolytic Aerosols and Fire Detectors | 29,759 | 1978 |
| Lawrence Berkeley Laboratory | Fire Modeling | 58,268 | " |
| University of California, San Diego | Studies of Flame Extinction in Relationship to Fire Suppression | 32,497 | " |
| Lawrence Berkeley Laboratory | Polymer Combustion and Flame Chemistry | 62,550 | " |
| Georgia Institute of Technology | Investigation of the Properties of the Combustion Products Generated by Building Fires | 89,167 | " |
| Princeton University | An Experimental Investigation of Flame Spread Over Condensed Combustibles: Gas Phase Interactions | 75,969 | " |
| Lawrence Berkeley Laboratory | Thermal Radiation of Luminous Flames and Smoke | 45,000 | " |
| University of Notre Dame | Fire and Smoke Spread | 83,906 | " |
| Factory Mutual | Determination of Fuel Parameters for Fire Modeling | 63,710 | 1979 |
| IIT Research Institute | Preflashover Room Fire Model: Parametric Sensitivity Analysis and Development of a Submodel for Burning Furniture Items | 76,281 | " |
| Johns Hopkins University Applied Physics Lab | Fire Problems Research and Synthesis, Combustion Research | 159,500 | " |
| Clemson University | Antimony Oxide-Organohalogen-Polymer Substrate Interactions in the Solid Phase | 38,987 | " |
| University of Princeton | Smoldering Combustion Studies | 83,658 | " |
| Georgia Institute of Technology | Investigation of Smoke Formation by Polymeric Materials: Smoke Reduction Methods and Chemical Characterization | 81,606 | " |
| University of Montana | Ignition and Fire Spread of Cellulosic Materials | 71,600 | " |

| Organization | Title | Amount | Year |
|---|---|---|---|
| Brown University | Flame Propagation and Extinction for Solid Fuels | 42,803 | 1979 |
| University of Notre Dame | Fire and Smoke Spread | 12,000 | " |
| Lawrence Berkeley Lab | Thermal Radiation of Luminous Flames and Smoke | 45,000 | " |
| University of California San Diego | Studies of Flame Extinction in Relationship to Fire Suppression | 33,135 | " |
| California Institute of Technology | Experimental Study of Environment and Heat Transfer in a Room Fire | 78,131 | " |
| Lawrence Berkeley Lab | Fire Modeling | 58,230 | " |
| Harvard University | Home Fire Project | 323,000 | " |
| Pennsylvania State University | An Investigation of Fire Impingement on a Horizontal Ceiling | 22,867 | " |

2. *TOXICOLOGY AND FIELD FIRE DATA:*

| Organization | Title | Amount | Year |
|---|---|---|---|
| Johns Hopkins University | Fire Casualty Studies | 260,000 | 1977 |
| Johns Hopkins University | Effect of Fire Exposure on Health of Fire Fighters | 50,000 | " |
| University of Pittsburgh | Toxicity of Plastic Combustion Products | 43,698 | " |
| University of Utah | The Physiological and Toxicological Aspects of Smoke Produced During the Combustion of Polymeric Materials | 310,000 | " |
| University of Arizona | Evaluation of the Combustion Toxicology of Several Polymeric Materials | 22,575 | 1978 |
| University of Utah | Toxicological Evaluation of Material Combustion Products | 166,951 | " |
| University of Pittsburgh | Toxicity of Plastic Combustion Products | 126,323 | " |

| Organization | Title | Amount | Year |
|---|---|---|---|
| National Fire Prevention and Control Adm. | Major Fire Investigations (Joint Effort with NFPCA, NBS/CFR, NFPA) | 15,000 | 1978 |
| University of Utah | Toxicological Evaluation of Material Combustion Products | 60,000 | " |
| Johns Hopkins University | Evaluation of Toxicity of Combustion Products | 85,775 | " |
| U.S. Fire Administration | Fire Investigations | 15,000 | 1979 |
| Johns Hopkins University Applied Physics Lab | Fire Casualties Study | 133,900 | " |
| University of Pittsburgh | Toxicity of Plastic Combustion Products | 130,000 | " |
| Johns Hopkins University | Evaluation of Toxicity of Combustion Products | 106,833 | " |
| University of Utah | Indepth Considerations of the Toxicological Effects of Combustion Products | 118,805 | " |
| *3. HUMAN BEHAVIOR AND FIRE PROTECTION ENGINEERING:* | | | |
| Loyola University | Planning and Training for Fire Safety in Health Care Facilities | 44,378 | 1977 |
| University of Maryland | Behavioral Response Patterns in Fire Situations | 71,105 | " |
| University of North Carolina | Psychology of Arson | 41,577 | " |
| Portland Cement Association | Short Term Creep Tests at Elevated Temperatures | 30,000 | " |
| Portland Cement Association | Simulation of Realistic Restraint During Fire Tests of Floor and Roof Assemblies | 30,000 | " |
| National Fire Protection Association | Investigate, Analyze and Report on Major Fires | 18,585 | " |
| Stanford Research Institute | Decision Analysis Applied to Fire Problems | 48,613 | " |

| Organization | Title | Amount | Year |
|---|---|---|---|
| University of North Carolina | The Psychology of Arson: Theoretical Analyses with Suggestions for Applications | 38,948 | 1978 |
| Portland Cement | Fire Tests of Reinforced Concrete Beams | 34,000 | " |
| University of Maryland | The Determination of Behavior Response Patterns in Fire Situations, Project People II | 75,692 | " |
| Rome Air Development Center | Reliability Modeling of Smoke Detectors | 20,627 | " |
| Stanford Research Institute | Decision Analysis Studies in Fire Hazard Analysis | 101,035 | " |
| Textile Research Institute | Grant to Support TRI Research Project on "Flammability and Combustion Behavior of Textiles" | 6,000 | " |
| Underwriters Laboratories Inc. | Measurement of Air Flow Around Doors Under Standardized Fire Test Conditions | 25,000 | " |
| University of Massachusetts | Waking Effectiveness of Household Smoke and Alert Detector Devices | 89,487 | 1979 |
| University of North Carolina | Occupant Response Variability in Escape from Residential Fires | 32,138 | " |
| Portland Cement | Fire Tests of Reinforced Concrete Beams | 48,000 | " |
| U.S. Fire Administration | Provide Services for a New Voluntary Standard for Residential Sprinkler System | 200,000 | " |
| Integrated Systems, Inc. | A Proposal to Develop a Mechanical Designer's Smoke Control Manual | 98,600 (OA) | " |
| University of Florida | Network Models of Building Evacuation | 45,000 ($20K OA) | " |
| University of Maryland | Project People II | 83,189 | " |

| Organization | Title | Amount | Year |
|---|---|---|---|
| University of Washington | Human Behavior in Fire Situations: A Study of Post-Fire Interviews | 16,077 (OA) | 1979 |
| University of North Carolina | Plans for Action in Fire Emergencies in Group Home Settings for the Handicapped | 32,330 ($24K OA) | " |
| National Electrical Mfg. Association | NEMA Fluid Filled Transformer Flammability Study | 89,278 (OA) | " |

STATEMENT OF FREDERIC CLARKE
DIRECTOR, CENTER FOR FIRE RESEARCH
NATIONAL ENGINEERING LABORATORY
NATIONAL BUREAU OF STANDARDS
U.S. DEPARTMENT OF COMMERCE
BEFORE THE
SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES
FEBRUARY 27, 1980

I thank the Committee for the opportunity to describe some of the work going on at the Center for Fire Research, National Engineering Laboratory, National Bureau of Standards (NBS). The Center's work has been discussed in part in the testimony of several witnesses who have appeared before the Committee this month. In the Posture Hearings before the full Committee earlier this month, Federal Emergency Management Agency (FEMA) Director Macy and our NBS Director Ambler mentioned some aspects of the Center's program, with emphasis on analytical prediction of fire growth. In his testimony, Dr. John Lyons describes the legislative and administrative background interaction between FEMA's fire programs and the NBS fire research effort. He will also discuss in some detail how we handle our extramural program.

Attachment #1 of my testimony is a breakdown of funding sources for the Center for FY 80 which the Committee may find helpful in keeping track of the various aspects of our program. Attachment #2 is a list of the Center's accomplishments for 1979. However, I will confine these remarks to our work on the residential fire problem. Much of this research is supported by appropriated funds which come to the Center through FEMA and the U.S. Fire Administration (USFA). Mr. Gordon Vickery has highlighted the importance of the residential fire problem. We have targeted our research to address several aspects of the residential fire problem simultaneously: 1) the protection of potential residential fire victims; 2) advances in detection and suppression leading to improved residential fire safety; 3) improved understanding of the fire properties of building and furnishing materials which contribute to residential fires.

Key insights into the needs of fire victims have been provided by an in-depth study in the State of Maryland, carried out by the Johns Hopkins Applied Physics Laboratory and supported by the Center for Fire Research. In this study, the precise clinical cause of death was determined by autopsy for almost every fire victim to die in the State of Maryland in the last seven years. Although caution must be used in extrapolating the Maryland data to national trends, the Maryland results produce several important findings:

1. Smoke, not fire, is responsible for the death of almost all fire victims. The cause of death is predominantly carbon monoxide toxicity. The role of other, less well known, toxicants in incapacitating the victims cannot be excluded, but to date, we have not found them to be generally significant in the primary cause of fire deaths.

2. The majority of fire victims cannot be presumed to have been able to escape from the fire. Either they were very young (under age 5), intoxicated, or had some other identifiable infirmity, such as heart disease, which could have prevented them from escaping.

The second finding says that if we are serious about reducing residential fire deaths, we must provide time for the victims to be rescued, either by other members of the household, passersby, or arriving firefighters.

This, first of all, means we must provide the earliest possible warning of a fire and that in turn means smoke detection. The Center for Fire Research developed the performance test method whose essentials are now used in certifying virtually all single station residential smoke detectors sold in the United States. As you heard from Mr. Vickery, these smoke detectors are working; they are reducing fire losses. More recently, the Center has developed an instrument for testing smoke detectors in place in the home. This instrument is now commercially available, and provides a first opportunity to check up on detector efficacy once installed. It promises to be an immensely useful tool to those in the fire service who are concerned with residential safety programs. In the past year, the Center for Fire Research completed siting studies on the most advantageous location for smoke detectors, especially in mobile homes. This problem is particulary acute in mobile homes because of small rooms, low ceilings, and the presence of heating ventilation and air conditioning equipment, which disturb possible smoke flows. We know a great deal about the response of smoke detectors to smoke from fires. We know very little about the response of people to the detector alarms. For this reason we are sponsoring programs to establish the characteristics and intensity levels of alarm sound which will be most effective in alerting the potential fire victims and we are studying the response of people when awakened by the sound of the detector alarm. In 1980, our work in smoke detection will primarily be confined to studying the response of people to smoke alarm and to technical backup to the U.S. Fire Administration in field studies of detector effectiveness. In the more distant future, we plan to complete development of a second generation smoke detector test method based on the results of current studies of detector effectiveness.

Another improvement to reducing residential fires is the adaption of sprinkler technology to home use. In the most desirable case, a sprinkler eliminates the threat of fire altogether, but even light duty sprinklers can substantially retard development and lead to an increase in time before fire conditions make the atmosphere fatal to those in the home. In 1979, the Center helped support the residential sprinkler work carried out under the auspicies of the U.S. Fire Administration. In 1980, the Center will continue to supply technical support to that effort and will begin work on longer range measures aimed at reducing still further the cost of residential sprinklers.

Buying time for residential fire victims can also be accomplished by controlling the rate at which the fire itself develops. As you undoubtedly know, Mr. Chairman, the principal agent of residential fires are home furnishings. There has been a good deal of public concern expressed in recent months about the fire threat posed by the materials used in modern home furniture, notably cellular plastics such as polyurethane. At the Committee's request, we will be submitting for the Record a more detailed discussion of the cellular plastics question but for the moment let me point out that fire experience shows that furnishings have long been a residential fire problem. It is true that modern furnishings burn differently, perhaps more dramatically then the older generation, but present evidence does not suggest that the overall fire problem is any worse as a result. The fact is that our residential fire losses have always been disgraceful.

The principal ignition agent in fatal furnishing fires is the discarded cigarette. The Center developed a standard for determining cigarette ignition resistance for mattresses in the early 1970's, and this standard is now mandatory for all mattresses sold in the United States. In 1974, we submitted to the Consumer Product Safety Commission a companion standard for the cigarette ignition of upholstered furniture. This standard has not been put into effect by the Consumer Product Safety Commission. However in the past few months the upholstered furniture industry has begun a voluntary labeling program to identify furniture with improved cigarette resistance. I believe it is fair to say that a number of the technical elements being used in this program, and the essentials of the test methodology, are a direct outgrowth of the work done at NBS.

This Committee has been concerned also about the possible efficacy of a self-extinguishing cigarette which, if dropped on an article of furniture would go out before igniting the substrate. The Center for Fire Research now has a program underway to determine in quantitative terms just how quickly a cigarette must go out, or the temperature below which it must burn, to keep from igniting the upholstered furniture. We plan to have preliminary results available this fiscal year.

Let me stress that cigarette ignitions account for some 70% of residential furnishings fire deaths. The technology of avoiding cigarette ignition is quite different from avoiding flaming ignition. Articles which resist cigarette ignition may ignite readily when exposed to an open flame and vice versa. Unlike the cigarette scenario, open flame ignition can arise either from a very small source such as a match, or from a larger source such as a burning wastebasket. Materials designed to resist match ignition in general will not resist a larger source. Consequently our objective for controlling flame burning of furnishings has centered on controlling the rate of heat release by the article once ignited, rather than preventing flaming ignition.

We believe heat release is the key variable here. One of the principal problems in furnishings fires is that the residential rooms catch the smoke and hot gases, feed reinforcing heat back to the developing fire, and accelerate it. This acceleration can result in a rapid, sometimes almost instantaneous, involvement of an entire room in fire once a certain point in the fire is reached. This phenomenon, called flashover, severely restricts the time available for escape, produces very large quantities of smoke and toxic gases throughout the dwelling and often makes escape completely impossible.

Work in our laboratories has resulted in the development of a new and advantageous method of measuring heat release and has reached the point where we are able, for the first time, to relate heat release of individual furnishings to the likelihood of room fire flashover. Our knowledge has not yet advanced to the point of precise engineering recommendations, but this is clearly a breakthrough which relates laboratory measurements to full scale fire performance. This is a simple example of our analytical, or modeling, approach. Right now, an accurate estimate of room fire buildup requires that one build a replica of a complete room and burn it. This impractical situation will be remedied with the completion of a room fire mathematical modeling effort which has been under way at the Center and in allied universities for the past few years. We are now on the verge of using modeling techniques to address real, i.e. non-idealized, fire geometries and problems. Preliminary results such as the one I have just mentioned, are quite encouraging, and we expect within the next few years to make at least simple modeling tools available to the practicing engineer and regulatory official.

In summary, Mr. Chairman, our efforts to quantify and extend the time available for escape take a number of alternate routes with the same objective, buying time for escape and rescue from the residence. Indeed, the limited mobility or capability of fire victims may be a universal characteristic. For example, the Johns Hopkins' study can be viewed as showing that the needs of residential fire victims parallel the needs of handicapped individuals. The Center for Fire Research was host last Fall to a conference on Fire Safety for the Handicapped, and the articulation of the needs of the handicapped emphasizes that an approach aimed at delaying untenable fire conditions, providing fire hurt areas of refuge, improving means of egress, and increasing people's awareness of what to do in a fire emergency, are common denominators for those most at risk from fire.

The Handicapped conference is an example of our efforts to keep abreast of fire research needs, as well as to transfer the knowledge we develop back to the user. We have interacted extensively with the Planning and Education Office of the U.S. Fire Administration in preparing public education packages on smoke detectors, hospital and nursing home safety aids on the concept of flashover, and training packages for the Fire

Safety Evaluation System for hospitals and nursing homes. In the next few weeks, USFA and CFR will complete a public service announcement for television which dramatizes the hazards of flashover.

Our own technology transfer efforts continue to be centered on the voluntary standards system as well as conducting scientific and technical research for Government agencies with regulatory mandates. Center staff members contribute heavily to standards developed by the American Society for Testing and Materials, the National Fire Protection Association, and other voluntary standards groups. We serve as technical advisers to the major model building codes. We serve on a wide variety of Federal fire safety committees. I will be taking on the additional assignment of Science Advisor to the U.S. Fire Administration, a move intended to strengthen the USFA's position in developing a Federal fire research policy. This concludes my prepared remarks. I will be pleased to answer any questions.

Attachment #1

FUNDING, FY 80

Center for Fire Research
National Engineering Laboratory
National Bureau of Standards

| APPROPRIATED FUNDS | $K | |
|---|---|---|
| Directly to NBS | 1,112 | |
| Passed through from FEMA/USFA | 3,894 | |
| | | 5,006 |
| REIMBURSABLE FUNDS [1]<br>(other Federal agencies)<br>(Estimated) | | 3,500 |
| TOTAL (Estimated) | | $ 8,500K |

| ALLOCATIONS (Approximate) | | |
|---|---|---|
| Conduct of Basic Fire Research at NBS | 1,100 | |
| Fire Research Grants* | 2,300 | |
| Conduct of general Fire Research Program | 1,900 | |
| Reimbursable Research on Specific Projects for other Government Agencies | 3,200 | |
| TOTAL | | $ 8,500K |

[1] For Example: HUD, VA, HEW, DOE, etc.

*Includes approximately $300K in grants associated with reimbursable research work.

Attachment 2

## Center for Fire Research

## Significant Developments in Calendar Year 1979

### FIRE CHEMISTRY AND PHYSICS

- The technique of opto-galvanic spectroscopy (OGS), recently developed at NBS, has been applied to flame diagnostic studies. Metal atoms and oxides have been detected in flames in this manner at very low concentrations. Most recently OGS signals have been observed in flames containing no inorganic additives. The source of these signals is as yet unidentified.

- A new project has begun on the chemistry of soot formation. This joint effort with the Center for Mechanical Engineering and Process Technology (CMEPT) has been funded by the NBS Director using competence development funds.

- We have developed a unique capability in high resolution nuclear magnetic resonance of solids. This has been accomplished via a joint project and shared post-doctoral research associate with the Polymers Division. Six publications are in press or in preparation, leading to better understanding of polymer NMR spectra. The technique will be applied to studying the degradation of polymers under fire conditions.

- The effect of sample and source orientation on radiant ignition was studied. Results confirm the importance of gas phase energy absorption in radiant ignition and show that the details of the buoyant flow can greatly affect ignition behavior. The energy received at the pyrolyzing fuel surface may be significantly less than the incident flux measured in the absence of absorbing gases. These results cast doubt on the interpretation of some widely used radiant ignition tests.

- Over the past year the Department of Energy sponsored smolder work has focused on conditions that yield smolder initiation (ignition) in cellulosic insulation. The minimum temperature for an ignition producing heat source has been shown to vary most strongly (by at least 150°C) with the geometric factors characterizing the source and the surrounding insulation bed. Other factors, notably presence of smolder retardants such as boric acid, have much less effect on ignitability. These behavioral characteristics appear to be described by the thermal ignition theory.

- A general survey of flame and smolder inhibition of cellulose, involving some 185 inorganic compounds, was completed and partially analyzed. Some new types of inhibitors were discovered, particularly compounds including fluorine as an apparent effective component. A new flame retardant for cellulosic insulation was found that appears patentable and effective at low concentrations. The mechanisms of these effects are being investigated.

- Scattering intensity versus angle for a single smolder generated smoke particle has been measured (with assistance of the Center for Analytical Chemistry). Use of this measurement technique should allow significant improvement in the characterization of smoke from different sources and the design of optical smoke detectors.

- We finished the first stage of a study of the fundamental physico-chemical properties of buoyant diffusion flames (NBSIR 79-1910 "Purely Buoyant Diffusion Flames: Some Experimental Results." October 1979). The study quantifies some of the very significant differences between purely buoyant diffusion flames and turbulent jets, for example, radiation is higher by as much as 50% in the buoyant flame. A qualitative understanding of the source of these differences was obtained.

- The Third Annual Conference on Fire Research, held at NBS in August 1979, provided for a very effective exchange of ideas among CFR grantees, contractors, Center staff and others in the fire community. This year the Conference emphasized the basic aspects of fire research, such as smoldering combustion smoke and radiation, ignition, ignition and inhibition, enclosure modeling and flame spread (NBSIR 79-1916, October 1979).

- More than thirty extramural research grants and contracts to academic, industrial and independent laboratories are in operation, supporting all areas of the Center's program.

## TOXICITY OF COMBUSTION PRODUCTS

- Development of a test method for evaluating the toxicity of combustion products from materials with cooperation of industry, academia and other governmental agencies is continuing with an interlaboratory evaluation scheduled for completion in September 1980.

- Large scale smoldering fire experiments are underway to correlate the generation of toxicants with the laboratory toxicity protocol results.

- A convenient and reliable technique for determining the concentration of hydrogen cyanide in fire atmospheres has been developed and published.

- We completed research on the generation of phosgene from the thermal degradation of poly (vinyl chloride). The results show that toxicologically significant concentrations of phosgene can be produced under certain conditions, particularly in electrical fires, thus clearing up conflicting reports in the literature on this question. A report has been submitted for publication.

- A comprehensive report on the Maryland fire fatality study has been completed and will be published shortly.

## FIRE MODELING AND FIRE GROWTH

- The buoyant flow computer model has been successfully run to simulate plume growth in an enclosure. The model exhibits the same qualitative spatial and temporal structure observed experimentally for thermal (non-reacting) plumes.

- Smoke coagulation studies have led to the first mathematical model of coagulation in an unbounded buoyant plume and one of the first studies of coagulation in any flowing system. When the two models -- plume and coagulation -- have been combined, the analysis will yield detailed information needed for studies of fire detector design, test and siting.

- A room fire model was extended and applied to a series of experiments involving wood and plastic crib fires. The experiments investigated the effects of fuel type and amount, and ventilation through variations in doorway widths. Analysis of the data has quantified the difference in burning behavior of wood and rigid foam plastic of similar geometries. The results are presented in a two-volume report currently in review.

- A troublesome aspect of our room fire tests has been the discrepancy between measured inflow and outflow. This has been clarified as a result of an experimental study to measure door and window flows resulting from centered room fires of 50 to 150KW. Flow coefficients have been defined and determined. These are weak functions of fire size and opening configurations in the range considered. Of great importance was the finding that room flows can be accurately predicted from temperature measurements alone. The elimination of the need for expensive and troublesome flow instrumentation will considerably simplify fire tests.

- An analysis of flashover as an instability due to radiative feedback was made in collaboration with the Fire Research Station (UK). A joint paper has been accepted by Combustion and Flame. A significant result is the rather small difference in fire size which may trigger "flashover." Thus, for a given fuel source, enhancement of the burning rate due to the effect of the enclosure can cause a transition from stable burning to flashover.

- An analysis was made of flame spread data acquired in a radiant panel test apparatus under consideration by ISO and IMCO. The test, like E-162, the flooring radiant panel test, or the British spread of flame test, yields flame spread velocity as a function of incident radiant flux. By analysis of the data, it has been found that flame spread on a wide variety of materials can be described by two material "fire properties", one of which is the minimum radiant flux required for piloted ignition and the other is related to the rate of heat release under a given flux. Through this analysis, considerable insight has been gained about how to design meaningful flame spread tests and how to use rationally the output from such a test in hazard analysis.

- Our analysis of container ship hold ventilation resulted in a technical presentation by the U.S. representative at the June Intergovernmental Maritime Consultative Organization Meeting. At issue was the hold ventilation required if containers including flammable liquids as part of their cargo were to be stored below decks instead of above-deck. The recommendation from our study was that one air change per hour should suffice provided the exhaust was placed at the hold bottom. (The initial proposal had been for twenty air changes with no stipulation on the exhaust location.) The committee voted to accept two air changes per hour. This should result in a significant saving in installation and operating costs in U.S. ships, which are difficult to modify for high ventilation rates.

## IGNITION SOURCE CONTROL

- The project on flammability criteria for transformer dielectric fluids has been completed. Advances were made in technical analysis of the problem and in evaluating control alternatives. The essential features of needed test methods have been suggested. The final report is in Center review.

- A study leading to recommendations to the Mine Safety and Health Administration of appropriate test methods for conveyor belts in coal mines has been completed and the report drafted. Minor modifications to the existing MSHA test method are recommended.

*ISO - International Standards Organization
IMCO - Intergovernmental Maritime Consultative Organization

- A study of fire incident data, model building codes, and standards to identify fire safety problem areas with wood-burning appliances was completed for DOE (NBSIR 79-1731, May 1979). A study of potential fire safety problems of fire place inserts was initiated in response to their rapidly increasing popularity.

- A study was carried out for the Department of Transportation (DOT) to formulate fire safety guidelines for vehicles used in downtown people mover systems. Test methods and criteria were proposed for assessing the flammability and smoke generation of interior finish and furnishing materials to be used in such vehicles.

- We provided technical input to the Consumer Product Safety Commission (CPSC), influencing their endorsement, on a trial basis, of a voluntary industry program to reduce cigarette ignition of upholstered furniture.

- The Center is participating in the development of a fire test protocol for solar collectors and has recommended a set of code changes on solar heating and cooling systems for BOCA's Mechanical Code.

- A report describing the full-scale burning behavior of upholstered chairs was issued. This research provides the basis for the development of a new test method for measuring flame spread on upholstered furniture.

- A study was carried out for CPSC to determine whether flaming ignition sources could be generated by introducing electrical failures in the circuitry of television receivers. Even though it was possible to develop hot spots in excess of 500°C in late model television receivers, it was not possible to induce flaming ignition. This work has influenced the CPSC in their decision to withdraw their notice of intent to promulgate a mandatory standard for fire resistance of television cabinets.

## TEST METHODS AND MATERIALS EVALUATION

- The Flooring Radiant Panel Test, previously developed by CFR and adopted as Federal Test Method Standard 372, NFPA 253 and ASTM E 648-78, was incorporated into the Standard Building Code and Basic Building Code (pending) and is now being used by HEW and HUD in setting flammability requirements for flooring in corridors and exitways. It has also been referenced in the German Standard, DIN 4102.

- The Attic Floor Radiant Panel Test and the Smoldering Combustion Test, both developed by CFR for fire testing of thermal insulation, were adopted in the CPSC Interim Safety Standard for cellulose loose fill insulation (44FR 39938-40002, dated July 6, 1979); round-robin testing in support of these procedures were reported in NBSIR 79-1588.

- CFR conducted round-robins on two related test methods for CPSC and reported the results in:

  NBSIR 79-1930, Interlaboratory Evaluation of Cyclone Settled Density Test for Cellulose Loose Fill Insulation; and

  NBSIR 79-1922, Interlaboratory Evaluation of the CPSC-Modified ASTM E 84-77a Tunnel Test for Cellulose Insulation.

- A predictive model for determining transient temperatures of electric wires in insulated wall spaces was developed.

- The Smoke Density Chamber Test, developed by CFR and previously adopted as NFPA 258, was adopted by ASTM as E 662-79, under the title "Specific Optical Density of Smoke Generated by Solid Materials." The test is under consideration by ISO Technical Committee 92 (Fire Tests) as Draft Proposal DP 5659.

- Several CFR developed test methods have been prepared in draft form and proposed for adoption by the ASTM E-5 Committee on Fire Tests:

  Room Fire Test of Wall and Ceiling Interior Finish (ASTM E5.13).

  Determining the Resistance of Upholstered Furniture Material Assemblies to ignition by Smoldering Cigarettes (ASTM E5.15).

  Time of Ignition of Interior Finish Materials by Flame Impingement (ASTM E5.23).

- A laboratory scale rate of heat release test based on the oxygen consumption principle is under development. The oxygen consumption technique has been applied to a variety of intermediate scale experiments.

- We have completed a comparison of the determination of heat release rate of oxygen consumption and by temperature rise measurements in a proposed calorimetric apparatus. The former method gives results with minimal time lag and with integrated absolute values of heat release that agree with theory. The latter method shows a (correctable) time lag and lost energy problems due to thermal inertia. A paper is in press.

- A series of basement recreation room fire tests were run on selected floor-ceiling assemblies in order to provide data needed for the development of a fire endurance test for floor-ceiling assemblies in residences. This test would be used to provide the miniratings required by the HUD Minimum Property Standards.

- A series of full-scale burnout tests has been conducted in simulated prison cells. This is a necessary background support to the development of a Fire Safety Evaluation System for prisons. The purpose of these tests was to determine the total rate of heat and smoke production as a function of the size of opening to the cell and to estimate the impact of a fire in a prison cell on the overall tolerability in a large cell block. In addition to the value for prison evaluations, it is believed that there will be a serendipitous carry-over to atrium-type structures.

- Associated with the development of hazardous conditions in spaces adjacent to and removed from a room of fire origin is the integrity of smoke compartmentation. Two studies that directly bear on this problem have been submitted for review. These are: The Measurement of the Smoke Leakage of Door Assemblies During Standard Fire Exposures; and Fire Tests of Stairwell-Sprinkler Systems.

## FIRE DETECTION, CONTROL AND SUPPRESSION

- A report was published on the influence of the operation of central forced-air heating and air conditioning systems on the performance of smoke detectors in mobile homes. Recommendations regarding the effects and appropriate smoke detector siting requirements were forwarded to the Department of Housing and Urban Development for consideration.

- The initial phase of a project designed to provide data and guidance on means of optimizing detection system performance in health care facilities was completed. A report has been prepared reporting the results of full-scale fire tests designed to evaluate the response of automatic fire detectors to flaming mattress fires.

- An analysis was completed of an experimental program conducted at Factory Mutual Research Corporation (FMRC) to map ceiling environments to which fire detectors are exposed for various combinations of room geometry, ceiling configurations, fire type and detector spacing. The analysis was done to provide a basis for application of the experimental results to tailor the spacing of fire detectors under appropriate conditions.

- A computer model is being developed to simulate smoke migration in stairwells having pressurization systems. This model is intended to provide a useful tool for the design of stairwell pressurization systems in multi-story buildings. Initial work including field testing of multiple injection smoke control systems, has been published.

- A field study of smoke movement was conducted in the National Institutes of Health (NIH) Clinical Center. Techniques were used to measure simulated smoke movement under a range of environmental conditions. A report has been prepared describing the findings.

- A project was conducted to determine the ability of selected water curtain sprinkler systems and spray nozzle systems to reduce the flow of heated gases into a stairwell. Performance was studied in terms of cooling efficiency, efficiency of water usage, and reduction in the flow of combustion gases up through the stairway. A model was developed, based on evaporative cooling of the fire gases, and is presented in a report to be released.

- Full-scale experimentation has been ongoing to provide design information on health care facilities incorporating automatic sprinklers. A report has been published on the initial year's work, and a second, more comprehensive report is currently being drafted. The findings of this research has been transmitted to HEW for consideration in improving fire protection in health care facilities.

FIRE HAZARD ANALYSIS

- The decision analysis methodology has been applied to several fire problems. The major application has been the initiation of a multi-year project to evaluate alternatives for residential fire loss reduction based on cost/benefit considerations. An initial fire loss model has been developed, and modeling of the benefits of residential sprinklers will be completed in the spring. In addition, decision analysis efforts have been completed in the following areas:

  (a) Mobile home fire safety - assistance to the U.S. Fire Administration (USFA) in evaluating current standard effectiveness for HUD;

  (b) Transformer fluid fire safety - for DOE;

- Three special studies are near completion, under the sponsorship of USFA to assist in the characterization of national fire losses. These studies also support the CFR residential decision analysis in providing a greater degree of detail regarding accidental fires. These studies are:

  (a) Preparing specifications for editing the National Fire Incident Reporting System (NFIRS) data tapes, to identify faulty data elements and make corrections where possible.

  (b) Defining the potential and the problems inherent in linking fire incident data (NFIRS) with demographic data. The next step will be to couple fire incident data with details of human and property population characteristics.

  (c) Analyzing fatal fire incidents to determine why fire death rates are high in certain geographic areas and low in others; Reports on nearly all fatal fires in a one year period from 14 states are being collected and analyzed. Preliminary results indicate an excessive number of fires and fatalities due to portable heating equipment in the rural south.

## FIRE SAFETY DESIGN CONCEPTS

- The Fire Safety Evaluation System for Health Care Facilities has been published. It is now in the process of adoption as a part of Federal regulations by the Department of Health, Education, and Welfare (HEW) and inclusion in the 1980 Life Safety Code. A training program for the state inspectors has been instituted. As of this time technical personnel in all 10 HEW regions and in all 50 states have been instructed in the application of the Evaluation System.

- A methodology for cost optimization of the application of the Fire Safety Evaluation System has been published under the title "Economic Aspects of Fire Safety Health Care Facilities: Guideline for Cost - Effective Retrofits," (NBSIR 79-1902).

- The Veteran's Administration (VA) has officially accepted the FSES as an evaluation tool. All 28 VA regional engineers have been instructed in the application of the Evaluation System.

- The application of fire safety evaluation concepts to other occupancies has advanced but not yet reached a state of any new completed systems. The elements involved in residential facilities, halfway houses, and prisons have been identified and initial relative values fixed.

- A working model and grading system has been developed and is now in the process of peer review to appraise the additional fire risk inherent with groups of persons having physical or mental shortcomings who are housed in residential or family type living. The basic concept determines the increased difficulty in emergency evacuation of the building, occasioned by sensory, motor, and mental difficulties, as modified by the assistance available from other occupants or staff personnel.

- A major multi-sponsor workshop conference was held at NBS on fire safety for the handicapped. The conference has developed a baseline document covering current state-of-the-art, positions, and opinions; definition of the problem; evaluated experience with current practices and proposals; new proposals for action; areas for research; and general guidelines for action.

- More than fifty individual fire incidents in health care facilities have been analyzed to establish the behavioral response patterns in fire situations. Based on the collected data, a general behavioral pattern of health care personnel is being hypothesized.

- We have submitted for review a report on the first phase of an analytical approach for evaluating available egress time from fires. The application included in this phase covers a limited number of rates and estimates the amount of time available for egress in the room of fire origin.

- A major 5 year project on mobile home fire safety was concluded with the publication of extensive recommendations based on the most comprehensive test program in this area (NBSIR 79-1720).

ARSON PREVENTION AND CONTROL

- A method has been developed for the generation of standard concentrations of accelerants for calibration of portable accelerant detectors used in arson investigations. A report describing the method is being prepared for the Law Envorcement Assistance Administration.

- A review and appraisal of the psychology of fire setting was published. The paper provides a conceptual basis for classifying fire setters and understanding their motivations.

- The third draft of a Fire Investigation Handbook is not in editorial review. Publication in cooperation with the U.S. Fire Administration is expected in the spring of 1980.

## GENERAL FIRE SAFETY ACTIVITIES

- Members of the Center staff were active in national and international organizations involved in the development of voluntary standards for fire safety. As examples:
- NFPA 13D (Sprinklers for Dwellings). A draft standard was prepared and an extensive full-scale verification program was initiated with considerable CFR input.
- NFPA 72E (Detectors). Revised requirements for detector spacing based on CFR-sponsored research.
- NFPA 74 (Household Fire Warning Equipment). Draft revision dealing with detector location and response based on CFR research.
- ISO TC21 (Fire Fighting). Draft protocol for full-scale testing of detectors prepared and supported by CFR testing. Draft test methods and product standards prepared for elastomeric seals used in sprinkler alarm check valves and dry pipe valves.
- Members of the Center staff serve on the FAA Special Aircraft Fire and Explosion Reduction (SAFER) Advisory Committee, the NFPA Standards Council and Underwriter's Laboratories Fire Council.
- In the area of building codes, members of the Center staff have worked actively with the Model Code Organizations, the National Fire Protection Association, and state and local building officials to introduce code changes which reflect the results of our research and the experience and expertise of our staff.

Mr. **Brown**. Thank you, Dr. Lyons.

Dr. **Clarke**. I have submitted my formal statement for the record.

Mr. **Brown**. I think our general reaction to the work you have described seems to be fairly well agreed upon that it is an excellent program and we heard no substantial criticism in the fire community with regard to the earthquake program that would indicate there is anything other than an excellent activity going on there.

I think our major question is the way in which this program relates to the other kinds of programs that are going on and whether the relationship provides an adequate foundation for the program.

For example, you mentioned the fire research program totals over $8 million, of which only about $1.25 million is what you might call base program—maintaining an existing organization there.

While apparently you have reached a rational and fairly long-range cooperative planning relationship with the Fire Administration and possibly the other concerned agencies, I am wondering what this large proportion—relatively large proportion—of passthrough money does to the stability of your overall operation in this field?

Dr. **Lyons**. Well, I think that is an item of concern, Mr. Chairman, but the way the money has come to us—I guess it is now 6 years—has been a secure route. We have not suffered cuts. We have not had serious disagreements with the Fire Administration as to how the money should be spent. It has not been cut significantly in the zero-base budget activity either.

In that sense, it seems to us it is fairly stable and, in some ways, we look upon it as base. One can imagine another scenario, but that has not happened.

I think there are two other encouraging signs about that. One is the OMB guidance. When the Fire Administration was transferred out of the Department of Commerce, OMB was very clear that the money for the line item in the budget marked for the Fire Research Center was to be treated as a passthrough from FEMA to the Bureau.

Also, the language of the authorization bill sumbitted to you by FEMA with OMB clearance is very clear. It amends section 16(b) of the NB, organic art by authorizing "to be appropriated for the use of the Fire Research Center, National Bureau of Standards, an amount not to exceed $4,005,000 for the fiscal year ending September 30, 1981". This seems to me to be quite powerful language.

Mr. **Brown**. It is.

You still have the item of $3.5 million from miscellaneous, other sources. I presume that you are not as well able to plan for long-term utilization of those funds?

Dr. **Lyons**. That is correct, but this funding from other agencies is large enough and diverse enough and the demand is strong enough that we have not had any difficulty. We have not had to let people go.

Mr. **Brown** Yes; that, of course, is the item that would concern you from the management standpoint. If you use these funds merely to contract for research externally, the budget would not be as much concern from a management standpoint.

Can you give us a rough idea of how much of this total is used for research conducted in-house and how much of it you contract to external research.

Dr. Lyons. Out of $8.5 million, $2.3 million is on grants of which about $2 million is from the FEMA source and about $300,000 is from the other agency source.

Mr. Brown. I will use the terms grant and contract interchangeably here because I don't know the difference.

That still leaves the preponderance of the money to support your in-house staff research?

Dr. Lyons. Yes, sir.

Mr. Brown. In your opinion, that does not constitute any particular problems?

Dr. Lyons. No.

Dr. Clarke. Excuse me, I would like to add that our planning activities depend heavily on being able to make use of results from specific projects in filling in gaps along the general improvement of knowledge of fire phenomena. We have a large enough base and a large enough series of other agency projects that, generally speaking we are able to piggyback, as it were, fundamental questions on some of the specific other agency-related projects. It often depends on how one plans it and how one manages it.

In addition, a number of those programs—I can think, for example, of the work we had done for Health, Education, and Welfare, who were interested in hospitals and nursing home fires—are multiyear programs. So there is an opportunity there to plan with reasonable assurance—budgetary restrictions not getting too severe—that you will have that money relatively long term.

Mr. Brown. You mentioned, in passing, toxicology research. That does not strike me as one of the things that I would normally think the Bureau is engaging in. I think you made the point that it is basically the standardization purposes that you are engaged in, in that.

There is a national toxicology program, I guess, led by HEW and aimed at serving as a coordinating function for all the various toxicology activities going on in various departments.

Would you care to comment about your relationship to the overall national toxicology program?

Dr. Lyons. We are close to all these people. One of the reasons we are close to them is that, on occasion, we have tried to hire some toxicologist. As you may know, Mr. Chairman, they are among the scarcest manpower or womanpower that we have.

Mr. Brown. Correct.

Dr. Lyons. We have been close to them. They have been close to us. They have been advising us. Some of the leading people in that community have participated in helping us with our program.

I think I should correct an impression I left. In my view, we don't do research in toxicology. We apply the principles of toxicology to the question of how to deal with the effects of combustion products on people.

Mr. Brown. Well, I was going to ask specifically on this. I assume that that would be the purpose behind this.

Dr. Lyons. Yes, sir. We have had grant proposals which struck us as appropriate for NIH or someone else and not for us, and we simply say that. It is a very applied and directed piece of toxicology work that we do.

Mr. **Brown**. Getting over to the seismic area for a moment. I was not clear. You mentioned a figure of $400,000-plus for fiscal year 1981. Was that the scope of your seismic safety program, or was that something else?

Dr. **Lyons**. That is the amount in our base for earthquake work. There is an additional reimbursement from FEMA this year of about $480,000. So our program is just shy of a million—slightly smaller than a million total.

Mr. **Brown**. I would like to ask you the same question as I have asked the other agencies as to where this fits within the schedule that was originally contemplated in the Newmark report and what you foresee as a future situation on that?

Dr. **Lyons**. As I indicated in my summary, Mr. Chairman, our role is to work on the designing provisions and the methodology and measurement sciences that will affect the way buildings are either constructed or repaired or strengthened. That is the traditional role of the Center for Building Technology in all aspects of our, building program.

That role is spelled out in various documents that have come out of the Office of Science and Technology Policy, and the President's plan.

As I indicated, the NBS role was said to be an important part of that program,.

Our immediate response to that—Dr. Wright's response—was to reprogram more than a quarter of milliom dollars from another part of the building technology program and apply it to this part.

With that money, he is doing some laboratory research. We showed you one piece of it when you were at the Bureau, Mr. Chairman. We are doing the work for the interagency committee which will lead, we believe, this fiscal year to new provisions for Federal construction.

Dr. Wright would like to comment on the Newmark report.

Dr. **Wright**. Well, I think in response to the chairman's question about the level of our work compared to the 1976 Newmark report, this was a report to guide the research programs in the Geological Survey and the National Science Foundation, and did not consider a program at the Bureau of Standards.

Mr. **Brown**. I won't belabor that. Four hundred thousand dollars is not nearly enough to do the kind of design research that needs to be done regardless of where it is coming from or who is doing it. We will take that into consideration.

What is your relationship to the problems of seismic structural design for other major areas, such as, nuclear power plants which are more the responsibility of the Department of Energy—dams or other major structures? We have been talking about buildings. I am asking you about these other nonbuilding types or building structures in a separate category.

Dr. **Wright**. There is specific other legislation dealing with the safety of dams and dealing with the safety of nuclear reactors, so that the program we have planned as part of the national earthquake hazards reduction program does not get directly in a programmatic sense into these areas. However, much of the technical work that we do is relevant to these other problems.

For instance, we have been called upon by the Nuclear Regulatory Commission to help them with their design criteria to protect nuclear reactors from tornado-driven missiles. So we have been involved in these other areas of safety from time to time when it particularly fits our expertise, but it is not part of our role on the earthquake hazards reduction program.

Mr. **Brown**. I am reminded of a specific incident which I wanted to ask you about in this area of seismic design.

Apparently, there was a new Federal building constructed in El Centro, near the earthquake fault line which failed completely, in the sense that the building became unusable. It did not collapse exactly; but, as I understand it, it is no longer in use and, effectively, therefore, it is our of commission.

My question is how does this impact on the code situation? If we find that a building is constructed to the very latest and best seismic code and then we get an actual event in which it does not hold up, does this trigger a process under which we try to analyze why and then change the codes or take some other remedial action in a situation of this sort?

Dr. **Wright**. Mr. Chairman, this is a very interesting incident that you bring up, because it has many technical and philosophical implications. Let me mention a couple of them.

For the code for which that building was designed, it performed successfully, because the objective of that code was to prevent collapse in a severe earthquake. The building did not collapse. The earthquake ground motion was reported fully in the magnitude at which severe damage would be suspected.

The tentative seismic provisions which we worked out with the building community at large through the Applied Technology Council and with the National Science Foundation, would call for a different design philosophy for that type of structure because it served as an emergency center for the local government. In the tentative seismic provisions, there are criteria that would call for a building of that type to be designed to do much higher levels of performance in order that it would remain useful during and after the earthquake emergency. We can't fault the designers of the building because it did not have that assignment nor can we fault the people who put together the previous generation of standards because they neither had the assignment nor the technology we have today to work with.

Also, that building is expected to be one of our great learning opportunities now because the ground motions were well instrumented, the building was well instrumented, and it was a very good experiment because major structural damage was encountered short of the type of collapse that makes it difficult to go back to observe what really happened.

So in terms of learning from earthquakes, that event and that damage are going to have a positive effect in our expectations.

Mr. **Brown**. I have a vague recollection, I think, from reading news reports—and I always read news reports about this area with great interest because I am familiar with it—that there was some unanticipated ground motion that it had not been designed for. It subjected the building to forces which were not expected. Am I anywhere near correct on this?

Dr. **Wright**. I am not certain enough myself to the detailed nature of the account to which you are referring to be sure that I am answering your question properly. I will hazard to answer it and it may be helpful;

but, if the question can be clarified, we would be happy to provide a more detailed answer.

The types of ground motion that were designed for by the seismic codes that are currently in effect are highly simplified. They give no indication of any vertical motions whatsoever, yet we know these are roughly the same order of magnitude as horizontal motions.

They consider only one direction of motion at a time, and they use a peak level of ground acceleration that is really lower than is actually expected because it is calibrated to the way you use the motion in design rather than trying to be a precise measurement of how the ground will move.

So there are many very good reasons for the actual ground motion to deviate from that which was used in designing.

Mr. Brown. My main concern really is the degree to which you do make use of this as a research opportunity and whether the lessons presumably learned are fully reflected in your activities in terms of standards and codes and any other necessary societal response, whatever it might be. It is unfortunate that we don't learn from our mistakes enough, including congressional mistakes quite frequently.

Do you have some questions, Dr. Ziman?

Dr. Ziman. Yes, I do. The first question I have deals with your authority. As you know, only USGS and NSF were really authorized in the 1977 Earthquake Act. NBS was mentioned in there as one of the other agencies.

Do you think that, by authorizing NBS, would change the philosophy and probably the funding picture for you—give you a more clear advantage?

Dr. Lyons. In my personal opinion it would. I think the fact that the Earthquake Hazards Reduction Act of 1977 does not authorize appropriations for the Bureau has caused some resistance to our budget proposal. People point out to us that the other two agencies have the bulk of the funding and have clearer authority, whereas ours is a little less clear. I think that has caused us some difficulties.

Dr. Ziman. Has that caused difficulty within the Department of Commerce itself?

Dr. Lyons. I think so.

Dr. Ziman. Could you describe either for us or for the record what the difficulty was?

Dr. Lyons. Well, exactly what I said. As I testified earlier this month, we made a proposal for an increase in this area of some $3.2 million to address our responsibility. That was one of the reasons why it did not get a high priority when the Department prioritized its budget initiatives; mainly, that we did not seem to have an equal place under the sun in the legislation because we were not specifically authorized.

[The material referred to follows:]

The $3.2 million initiative for earthquake hazards mitigation discussed above was submitted to the Department of Commerce as the National Bureau of Standards' lowest priority item in its budget request for fiscal year 1981. The President's budget for fiscal year 1981 includes $425,000 for that activity. H.R. 6326, the Administration's authorization bill for the Bureau, contains an authorization of appropriations for earthquake hazards mitigation in that amount.

Dr. Ziman. In both a letter in answer to some of staff's questions from Mr. Macy to Mr. Brown and, also, in what we now refer to as

"Son of Newmark," we have some projected increases in funding for NBS.

Again, either for the record or if you care to answer, could you tell us what you could do with the base program and the increments and what the difference would be in funding—what can you accomplish?

Right now, it seems to me you are rather limited in what you can do next year and you can only approach one major problem, and that might be the Federal Interagency Committee on Seismic Safety and Construction. Even there you may run into a problem next year of having the funds to carry out the testing, so that this set of standards can be applied.

It think it would be helpful for the record to tell us what more you can do.

Dr. LYONS. Yes. First of all, we are familiar with that letter from Mr. Macy, and it does mention the Bureau in a number of places in a helpful way, in my opinion.

I earlier referred to what we would do with the existing base of $425,000; namely, we will continue the small laboratory research program that is going on. We will complete the work for the Federal standards. If that's not completed in fiscal year 1980 we will certainly clean it up in 1981.

Beyond that, the program that we proposed in our initiative would expand our activity and provide design provisions and suggestions which would ultimately lead to improved codes across the country. It does include addressing the tentative provisions now under study by the Building Seismic Safety Council and does have a very substantial diffusion program to be done once we finish the development of our measurement techniques and our proposed standards for use in codes.

We can give you more of that for the record or Dr. Wright could probably give you a dissertation at this time, if you would like.

Dr. WRIGHT. I am at your service, Mr. Chairman. I can talk for just a couple of minutes about the nature——

Mr. BROWN. Please do. I would like to have further explanation if you can do it.

Mr. WRIGHT. As Dr. Lyons pointed out, the base level of funding keeps a toe in the water. It can't be considered to be funding available to the bureau to carry out either the entire Federal programs described in the President's Earthquake Hazards Reduction Act Program or the program of underlying applied research that is needed to prepare for the development of improved standards in the future.

The part of research the bureau would do would build upon the very strong research base being created by the National Science Foundation and the Geological Survey and develop on the base of this research with extra work those things needed for really effective design provisions.

With the funding that was in our proposal, it would be possible to move forward with collaboration with the other Federal agencies and with the Building Seismic Safety Council in the prompt testing and improvement and implementation of a new family of seismic design provision.

In my personal opinion, it is something that is very badly needed.

In addition, the program of research that we proposed would have focused attention to the major looming problem which are hazardous existing buildings. This has, I think, of necessity been a second priority to stopping doing wrong things in new construction, but we have a very large inventory of very hazardous buildings, and we don't even have very good ways of finding (a) which buildings are the most hazardous and then, (b) how to precisely identify their conditions and arrive at cost-effective ways in strengthening them.

So that, in a nutshell, is the difference between what we can do with our base funding and what we feel we could do.

Mr. BROWN. You had contemplated activity with regard to these additional items in the initial proposal that you made; is that correct?

Dr. WRIGHT. That is right.

Dr. ZIMAN. I just want to ask one other question. You talked about that FEMA letter. Do you happen to know whether or not the views expressed by FEMA represent those of the administration and OMB. Do they go along with this?

Dr. LYONS. I am not an expert on that. I have inquired. My impression is that is FEMA's opinion.

Dr. ZIMAN. Thank you, Mr. Chairman.

Mr. BROWN. Do you have any questions, Tony?

Mr. SCOVILLE. Yes, Mr. Chairman, I have two questions.

First, on the fire program, what is being requested in the budget for antiarson efforts? I know you have that one study of a psychological profile of arsonists, but what in addition to that is being requested?

Dr. CLARKE. I believe there is a proposal for a supplemental appropriation for arson which is working its way through the budgetary network of FEMA. That is an outgrowth of the arson report that was submitted to this committee, I believe, a few months back. As I recall, we estimated that $400,000 would be needed for improved detection methods for arson and a comparable amount for improving the methods by which arson detection equipment is purchased and evaluated. So something of the order of $700,000 or $800,000 was contemplated to underwrite appropriate new activities for the bureau, as mentioned in the report.

At present, our efforts in arson represent a reduction of funds from some other areas.

Mr. SCOVILLE. About how much is that?

Dr. CLARKE. About $100,000 of our own funds and a comparable amount on a grant from Law Enforcement Assistance Administration, specifically, in improving combustible gas detectors.

Our own work is involved in a fire investigator's handbook, improve the technical facts available to fire investigators.

Mr. SCOVILLE. That 100——

Dr. CLARKE. Yes; I would like to point out that it is money appropriated through the Fire Administration.

Mr. SCOVILLE. Is that $100,000 essentially the same level antiarson work that you were doing prior to the report; isn't it?

Dr. CLARKE. Yes; the work was begun before the report was completed.

Mr. SCOVILLE. Given the fact that Congress authorized last year a roughly $5 million antiarson program, which I think the bureau was authorized about $500,000 a year, can you tell me why the administration chose not to submit a request for funds for this additional comnent? Is there any reason as to why?

Dr. CLARKE. Mr. Scoville, I would have to speculate on why FEMA has not secured funding for this effort.

My recollection is that the report to Congress was not completed at the time—at the time the budget went forward this last year.

Mr. SCOVILLE. I discussed this yesterday with the Fire Administration. First of all, the report was mandated in time for the budget cycle. The final version was submitted late and may have pro forma overstepped some of the timing steps of the budget cycle.

In fact, we had a draft of it in our hands and, presumably the administration must have been aware of the general tenor of thinking.

I guess I would like to know, given that certain of the information was available and the general conclusions were there and, in fact, it was mandated by Congress to be produced in time for the budget cycle, why the—well, I guess, I am not quite sure that it is a totally satisfactory answer to say that it missed the budget cycle as to why they requested it, or, well, maybe do you anticipate further request in the future?

Dr. CLARKE. Yes; I would expect that FEMA will make such a request.

Mr. SCOVILLE. Since we will have to be considering that in connection with our authorization this year, even though it has not been formally requested, could you give us for the record what you would think would be a suitable authorization level for this program? Would that be the $800,000 figure that you were talking about? Would that be the order of magnitude that you are contemplating in this request, if the request comes up?

Dr. CLARKE. Yes; that is approximately the amount that we proposed to FEMA.

Dr. LYONS. Excuse me a moment, Mr. Scoville.

Mr. SCOVILLE. Yes, Dr. Lyons.

[Dr. Lyons and Dr. Clarke conferred.]

Mr. SCOVILLE. So, in other words, given that the request has not come up but it may come up sometime in this fiscal year, if we were to authorize the Bureau at about the level—if assuming the committee and the Senate has had particular interest in this program—the roughly $800,000 figure would be about right, if we had to designate a number?

Dr. CLARKE. We would not be handicapped by a spillover of the appropriations above authorization, if you were to do it at that level.

Dr. LYONS. But your point is well taken, Mr. Scoville. If the ceiling is not raised, we can't do it.

[Material referred to follows:]

The supplemental appropriation for anti-arson activities discussed above is a budget amendment for fiscal year 1981 being considered by the U.S. Fire Administration. If the amendment is ultimately submitted to Congress, it will request appropriations for the Fire Administration. The amendment might require that the authorization of appropriations for the Fire Administration be increased. However, no increase in the authorization of appropriations for the Bureau would be required since appropriations for the Bureau would not increase.

Mr. SCOVILLE. Well, we have to deal with it in any case for the next fiscal year.

Another question is, that there was initially a request for about $3.5 million for earthquake-related activities in the Bureau of Standards. I guess, the Department of Commerce withdrew its request for that and then eventually proposed the $400,000 level which is in the President's request.

Can you, first of all, tell me what the additional, roughly, $3.2 million would have been applied to; second of all, perhaps, on what grounds was the request withdrawn? What was the general rationale for not proceeding with the request all the way to the Congress? Since your budget does not have the money, does FEMA or any other agency, to your knowledge, that have those programs which you would have carried out and, if they don't, I guess, we would like to know why they don't? Essentially, in other words, where did it all go and, if it just vanished, why?

Dr. LYONS. Let me try to take those in sequence.

First, we did ask for an increase in the order of $3.2 million to add to the base to which you referred for work that Dr. Wright was just describing; namely, the development of measurement technology, the evaluation procedures, proposed standards and code revisions and the related activities necessary to diffuse these throughout the country.

Mr. SCOVILLE. Is it my understanding, from what you are saying, that this essentially would have been an effort to try to take some of the work that the seismic building code group is doing and that would be basically a technology transfer operation, to try to get it out to State and local governments?

Dr. LYONS. Yes. A great deal of it is, indeed, technology transfer, but some of it is research—laboratory work—that fits particularly with our expertise.

Mr. SCOVILLE. Am I correct that, under the current program, there is some research but very limited technology transfer done?

Dr. LYONS. I think, Mr. Scoville, your analysis is correct. I think the point here is that the Bureau is identified in the documentation of this program as the agent for what I will call diffusion or technology transfer. It is a bit more than just transfer.

Mr. SCOVILLE. Right.

Dr. LYONS. It is a conversion of research results, such as NSF generates on the construction problem into the language and the every day working tools of the designer and the regulator. That is a role that was foreseen for the Bureau and, to my knowledge, it is not in anyone else's budget.

Mr. SCOVILLE. Can you tell me why it is not or do you have any idea as to why it is not? Was there any directive as to——

Dr. LYONS. Yes, I can address that very specifically. In the President's memorandum to the agency, which you have, first of all, the role was spelled out and then each agency was told to consider the needs of its particular portion of the program in developing its budget. So it was clear, for example, that FEMA was not supposed to ask for all the money and then pass it around, but rather each agency was to address its own needs. That's the reason that the FEMA budget has a smaller piece in it for research because the BNS was supposed to ask for its piece as were USAS and NSF.

Mr. SCOVILLE. Am I correct in, perhaps, understanding that technology transfer and diffusion of results is somewhat the responsibility of FEMA and research somewhat the responsibility of NBS and yet, somehow, FEMA was not given the sort of authority to ask for the additional money to this on?

Dr. LYONS. I don't think that is entirely correct. Let me comment and then Dr. Wright would like to comment.

It is well known that the Center for Building Technology has very considerable expertise and close to 80 years of experience, in doing the kind of research and measurement work which leads to modification of codes. It is one of the strong suits that the Bureau has—our participation in that chain, at least from the research to the local government actually adopting modifications to codes. This is one of our strong suits recognized in the plan.

It is certainly true that FEMA is worried about diffusion and dissemination of results. That is part of the charter. But the Bureau's expertise in doing building code work, I think, is well recognized.

Dr. **Wright**. Just to comment on the term "technology transfer" that you used Mr. Scoville and to identify the thrust of the work that we propose.

We anticipated a major part of the program to be focused on the priority Federal program to assist the private sector, the State and local governments, the design professions, the manufacturers, and others concerned in the development of comprehensive seismic design construction provisions.

This, I think, is much more than technology transfer. It involves in-depth technical studies to answer both the physical questions of performance and safety, and the economic questions of what are the most cost-effective strategies to arrive at the appropriate levels of safety.

We have been able to carry out in a timely way the initial steps of this responsibility, not as was envisaged in the President's programs by our requesting funding in our budget, but as the result of funding that FEMA has made available to us to initiate the studies.

So I say this is much more than technology transfer. It is really the development of usable design and construction practices.

Mr. **Scoville**. I appreciate the fact that there is a lot of technical work—development work—that is going on there in that $3.2 million, but I guess what concerns me is that, in many cases, there has been an interest in Congress in trying to see the importance of getting the results of research and development activities such as the work you are doing out to the public—to the user—whether it is the private sector or State and local governments.

It seems strange to me that the administration has not, at least, requested funds to try to undertake the diffusion component, granted not all that $3.2 million was going to the diffusion end; but, in terms of making a workable product, you still have to get the product out in the field.

It just seems to me strange that, given the need to get Federal research and development better used, that they did not come forth with a request. I guess that's really what I was trying to determine—what the rationale was for it.

Mr. Chairman, thank you very much.

Mr. **Brown**. Gentlemen, I think that will conclude our questions for this morning. You have been very helpful to us. We will continue to keep in close touch with you if we need any further information.

Dr. **Lyons**. Thank you, Mr. Chairman.

Mr. **Brown**. The subcommittee will be in adjournment.

[Whereupon, at 11:25 a.m., the subcommittee adjourned.]

[Additional material submitted for the record follows:]

**UNITED STATES DEPARTMENT OF COMMERCE**
**National Bureau of Standards**
Washington, D.C. 20234

Honorable George E. Brown, Jr.
Chairman, Science, Research
  and Technology Subcommittee
U.S. House of Representatives
Washington, DC 20515

Dear Mr. Chairman:

In response to a request by Mr. Tony Scoville of your staff, I am attaching a discussion, for the record of your February 27, 1980, Fire Authorization Hearings, of the principal issues, as we see them, which arise from the residential fire problems associated with furniture.

We thank you for the opportunity to make our views a part of the record, and we will be happy to supply you or the Committee Staff with any additional information you may require.

Sincerely,

Frederic B. Clarke
Director
Center for Fire Research

Attachment

# REDUCING RESIDENTIAL FIRE DEATHS FROM FURNITURE;

## THE NATIONAL BUREAU OF STANDARDS' VIEW

Prepared By:

Staff of the Center for Fire Research
National Engineering Laboratory
National Bureau of Standards
Department of Commerce

## I. INTRODUCTION

In the past few months, public attention has been focused on the fire hazards associated with upholstered furniture, particularly the performance of those articles using substantial quantities of urethane foam. The Center for Fire Research, National Engineering Laboratory, National Bureau of Standards, maintains an active research program in the furnishings area. In response to inquiries on this subject from Congressman George Brown, Chairman of the Subcommittee on Science, Research and Technology, of the House Committee on Science and Technology, the Center is taking the opportunity to put on record its view of the extent of the problem, and to set forth the principal technical issues involved.

In the following sections we will examine the magnitude of the fire problem associated with upholstered furniture, mattresses and bedding (referred to collectively here as "furniture"); the important distinctions between the two kinds of furniture fires; the hazards associated with each (particularly the concept of "flashover" or full room fire involvement); means of controlling furniture materials* to reduce the hazards and the technical aspects of each approach.

First, a few general remarks are in order. The first is that the visual aspects of a fire, and the drama associated with heat and flames can easily distract attention from other important lethal aspects, which are the smoke and toxic gases. Recent studies have confirmed what fire officials have long suspected, that it is the chemical products of combustion, not heat and flames, which disable and eventually kill in most residential fires. In many such fires, flames may not even be present. There has been a great deal of concern that the toxic gases associated with new plastic materials are more toxic than those produced by the burning of traditional materials. Autopsies of fire fatalities lend little support to this view. Carbon monoxide has been, and continues to be, the primary toxicant and the cause of death in the vast majority of fatal fires. Other toxicants may play secondary roles in some cases, and research is continuing to determine what these roles may be. However, the present evidence supports the view that modern furnishings offer risks which may differ in degree, but not in kind, from traditional materials.

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*This document addresses only those strategies for controlling residential fires which can be effected by modifying the furniture materials or construction. It is not our intent here to discuss other promising approaches, such as smoke detectors, residential suppression systems or self-extinguishing cigarettes, although it is recognized that they have an important potential for reducing furniture-related fire losses.

Another point centers on the notion expressed in the popular press, that synthetic materials, such as polyurethane resemble "solid gasoline," inferring that somehow the hazards of the two are similar. It is true that cellular cushioning materials, like gasoline and other hydrocarbons, generally produce more heat when burned than do comparable weights of wood, cotton or other traditional materials. However, the analogy is misleading on at least two counts. First, gasoline, or other highly volatile organic liquid, is particularly hazardous precisely because it is not a solid, but produces quantities of vapor for combustion, which can be ignited by a spark. Second, and much more important, the analogy fails to focus on the real issue, which is the rate at which materials burn rather than the amount of heat they eventually produce. The hazard we intuitively associate with gasoline reflects the great rate at which it burns, which in turn is due to its great volatility. Under most conditions, the burning rate of gasoline is far greater than that of foam plastics.

## II. THE SCOPE OF THE FURNITURE FIRE PROBLEM

Fire officials have long been aware that the principal threat to life from a residential fire comes from the burning of furnishings, not from the structure. Statistics compiled over some 20 years by the National Fire Protection Association's Fire Incident Data Organization (FIDO) show that furnishings, especially upholstered furniture and bedding, have been the largest fuel source in fatal residential fires. While we are only now developing detailed fire experience data nationwide, the figures available do not show that, overall, the arrival of new plastic materials for furniture has made the problem any worse. It has always been severe.

Specifically, we estimate that furniture may play a key role in some 66%, or two-thirds, of all residential fire deaths (see Table I). This role can be played in either of two ways.

1. *Furnishings are the item first ignited.* Since fire investigators, upon whose reports fire data are based, can most readily identify this situation, most discussions center on fatalities in which furniture is found to have been ignited directly by the ignition source. This category accounts for approximately 40% of residential fire deaths.

2. *Furnishings are not initially ignited but play an important role in fire buildup.* That is, they contribute the fuel and cause the rapid burning rate which leads to entrapment and is instrumental in many fatalities. When the furnishings are not first ignited, however, our ability to reconstruct their role from fire incident reports is severly hampered. We estimate that another 26% of residential fire deaths fall in this category.

## TABLE I

### ROLE OF FURNISHINGS* IN RESIDENTIAL FIRE DEATHS
(Source: NFIRS Version 3 Data Base)

| | Category | | % Total Residential Deaths |
|---|---|---|---|
| 1. | Furnishings First Ignited | | 40 |
| | Smoldering Ignition[1] | 31 | |
| | Small Flaming Source[2] | 7 | |
| | Large Flaming Source[3] | 2 | |
| 2. | Furnishings Not First Ignited But possibly involved in fatal fire[4] | | 26 |
| 3. | Furnishings Probably Not Significantly Involved in Fatal Fire | | 34 |
| | | | 100 |

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*Mattresses, Bedding and Upholstered Furniture

NOTES:

[1] Smoking materials, ashes and embers

[2] Electrical arcs, candles, matches, lighters, light bulbs, properly operating electrical equipment, static sparks

[3] All other known sources, e.g. heating equipment

[4] Residential deaths where furnishings not first ignited, but where area of origin is living- or bedroom and fire not confined to object of origin.

Even within each category, however, the scenarios leading to fire fatalities, and what can to be done to avoid them, are quite varied. We will discuss these categories in turn.

A. Fire Deaths Where Furnishings are First Ignited. (40% of total)

Reference to Table I, Category 1, will show, that 31% of the total is contributed by smoldering igntion. For the most part this is a dropped cigarette which ignites either a mattress, an upholstered chair or couch. Such fires begin in the smoldering mode and invariably continue to smolder for a substantial period of time. After the smoldering is well advanced, typically from one-half to two hours, they may become flaming fires or they may continue to smolder until the entire article has been consumed. Either mode can kill.

Some 7% of the fire deaths are traceable to ignition by a small flaming source, e.g., matches, lighters, or electric sparks. These fires seldom smolder, but immediately begin growing and spreading. The development of high levels of smoke and toxic gases will occur much more rapidly than if the ignition is from a smoldering start.

The remaining 2% in this category are the result of ignition from a relatively large ignition source, such as a space heater. Since the fire begins with a bigger source, the initial fire is larger and there is even a bigger head start toward the development of lethal conditions.

The distinction among these three categories of ignitions is very important because the three types must be prevented in different ways. Control of cigarette ignition, such as the Consumer Product Safety Commission's (CPSC) mandatory mattress standard or the Upholstered Furniture Action Council (UFAC) upholstered furniture program, addresses the smoldering problem; control of smoldering ignition is not effective in preventing ignition from small or large flaming sources. Similarly, a test for furnishings which uses a small open flame is not by itself effective for smoldering ignition or for protection from large ignition sources. Finally, there is no accepted test for, or widely applicable means of preventing, ignition of furnishings from a large flaming source. Therefore, prevention of each type of fire must be approached separately. It is no accident that Federal attention has focused first upon smoldering ignition since this is the bulk (31% out of 38%) of the problem that can be addressed by means of ignition control.

### B. Category 2 - Furnishings Involved in Fire Fatalities But Not First Ignited (26% of Total)

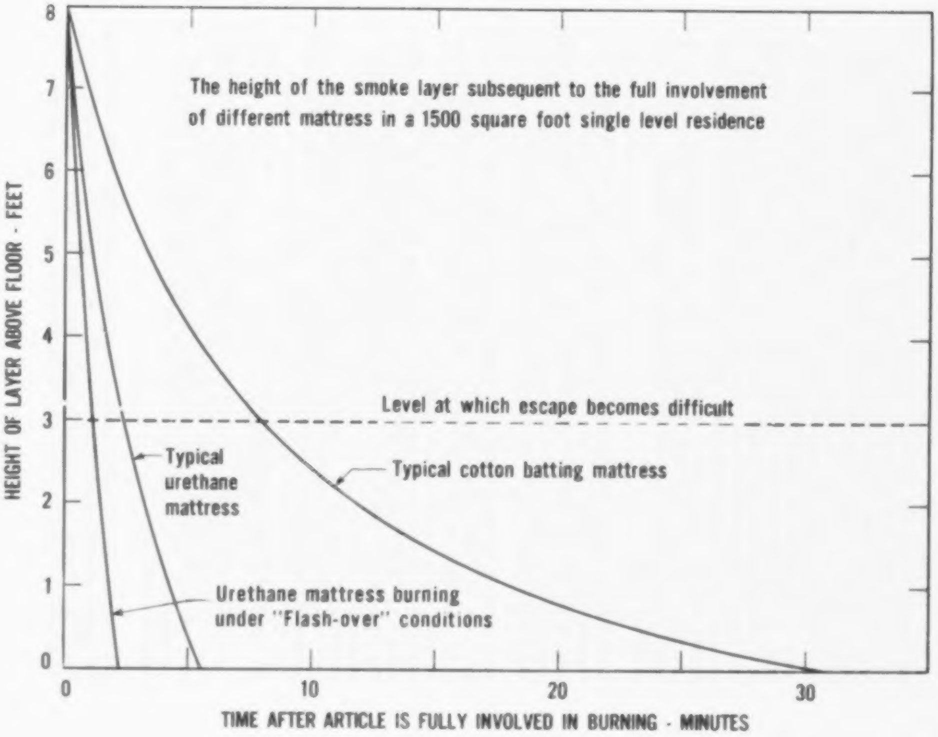
It is possible only to estimate the magnitude of this category (the basis of the estimate, which is an upper bound, is contained in the notes to Table 1). A typical scenario here would be initiated by ignition of a waste basket by a dropped match; ignition of the curtain by a space heater; or a small fire in a television set. For the fire to become a real threat to any but those in the immediate vicinity, it must spread to a larger source of fuel, and most of the fuel readily available in a living room or bedroom is contributed by furniture. The initiating fire may not be big enough to be dangerous in itself, but it is big enough to function as a large ignition source for the furniture. (We repeat that there is no accepted means of preventing ignition from large sources.)

## III. HAZARDS POSED BY FURNISHINGS FIRES

There are somewhat different degrees of hazards posed by smoldering and flaming fires. Smoldering fires can be lethal but proceed at a relatively slow rate of development. Flaming fires grow more rapidly and, if they grow rapidly enough, can lead to the phenomenon of room flashover (described below) which poses an extra threat. The generation of hazardous conditions is illustrated for three examples in Figure 1. The three examples are: 1) Curve A: smoldering fire typical of a cotton mattress; 2) Curve B: flaming fire representative of the burning of a polyurethane type mattress; and 3) Curve C: flaming mattress burning under conditions of flashover. (Analogous situations exist for the burning of upholstered furniture.) The approach of hazardous conditions is given by the filling of a typical residence with "smoke," which contains lethal combustion products. Being hot, the smoke layer collects initially at the ceiling. As more smoke is produced, the layer descends to a level (here taken as 3 ft.) where the carbon monoxide, heat, and reduced visibility restrict occupants' ability to escape. In examining Figure 1, it is important to keep in mind that the times shown are only after the material has become fully involved. In reality there is some additional time between ignition and the descent of the smoke layer during which the fire grows to involve the burning article completely.

### A. Smoldering Furniture

A smoldering fire generally begins in a very small area and develops by spreading through the material directly adjacent to the initial hot spot. Often a mattress or chair will smolder to completion, and no other article in the room will catch fire. Even so, there is more than enough smoke and carbon monoxide produced by such a fire


The height of the smoke layer subsequent to the full involvement of different mattress in a 1500 square foot single level residence
HEIGHT OF LAYER ABOVE FLOOR - FEET
8
7
6
5
4
3
2
1
0
Level at which escape becomes difficult
Typical urethane mattress
Typical cotton batting mattress
Urethane mattress burning under "Flash-over" conditions
0
10
20
30
TIME AFTER ARTICLE IS FULLY INVOLVED IN BURNING - MINUTES

to kill in the room of origin and the adjacent rooms. The reason smoldering fires are so hazardous in terms of their contributions to fire deaths (31% of the total), seems to be that they occur with high frequency when fire victims are asleep or incapacitated. Even though it may be many minutes or even hours before a threat to life exists from such fires, victims are unaware of the fire during much of its development, or they are impaired from escaping by reason of age, intoxication or immobility. Curve A of Figure 1 shows the time for buildup of smoke and gas levels resulting from a smoldering fire involving the mattress. Heat is not much of a problem during the smoldering phase of the fire; danger is almost entirely due to the buildup of smoke and carbon monoxide (CO). In general, furniture constructed of traditional materials such as untreated cotton batting, and wood, are more prone to smolder than are those articles which are characterized by the increasing use of plastics and urethane foam.

We do not know the frequency with which smoldering fires convert to flaming ones. This is a sensitive function of the ventilation available and the geometry of the burning article. However, available data indicate that the conversion is common. When it occurs, the situation is that of a flaming fire which is described below.

Transition from smoldering to flaming is most likely for composite articles of furniture, especially upholstered chairs and couches, which are made up of both cellulosic and foam plastic materials. In such cases, none of the idealized curves in Figure 1 applies alone, but rather a combination of smoldering and flaming combustion. Typically, the fire is started in the smoldering mode, because of the exposure of the cellulosic components, such as cotton, to the smoldering source. If the furniture bursts into open flame, the presence of foam plastic as a major fuel component suggests that the burning behavior from that point on will more closely approximate behavior typified by one of the open flame cases.

## B. Flaming Fires and Flashover

A flaming fire is much more likely to involve other articles in the room, thereby jeopardizing the physical state of the property as well as the safety of the occupants. Curve B in Figure 1 shows the development of a flaming fire due to the typical burning of a urethane mattress.

The descent of the smoke layer is far more rapid than with smoldering fires and therefore the time available for escape is correspondingly less. More rapid fire buildup would lead one to expect flaming furnishings fires to represent a larger fraction of fire deaths than is seen in the statistics. That they do not is probably attributable to the fact that residents are more likely to be awake in situations where open flames are around. One does not generally fall asleep holding a lighted match, but one may very well fall asleep holding a lighted cigarette.

It is upon the flaming fire that recent public attention has been focused. Experiments have shown that fires involving furniture composed of cellular materials, whether synthetic such as polyurethane or natural such as latex foam rubber, grow more rapidly and release more total heat than do fires in furniture constructed from wood, cotton and other traditional materials.

The time to reach untenable conditions is inversely related to the rate of fire development. If the development is fast enough, "room flashover" can occur. Any flaming fire is a race between how fast hot products are produced and how fast they are dissipated away from the vicinity of the fire. If the rate of heat production or release is too great, or if the rate of dissipation is too slow, the heat produced reinforces the developing fire and causes it to grow at an ever-increasing rate until it runs out of air or until all combustibles are consumed. At some point, the fire will be so large that burning occurs throughout the room, flames shoot out the doors and windows, and this phenomenon is described as flashover, or full room involvement. Flashover can occur with startling rapidity--in as little as two to three minutes from ignition in some cases.

Within a few minutes of flashover the entire dwelling becomes untenable. Flame spreads rapidly throughout the house and escape is difficult if not impossible.

Again we emphasize that the likelihood of flashover is directly dependent upon the rate at which articles burn. If the rate of heat release overpowers the ability of the room environment to dissipate the heat, flashover will occur. Flashover is observed often in our laboratory when modern furniture is burned; it is seldom observable when the only fuel source is traditional, cotton-padded furniture. Figure 1 also illustrates the attainment of untenable conditions when flashover occurs (Curve C). Note that the escape time is substantially reduced.

## IV. TECHNICAL ISSUES UNDERLYING MATERIAL CONTROL

### A. Resistance to Cigarette Ignition

Improved resistance to cigarette ignition for mattresses is now a fact as the result of mandatory national standards enforced by the CPSC. A voluntary program to produce cigarette resistant upholstered furniture is now being undertaken by UFAC. We believe that, as post-standard mattresses and upholstered furniture designed in accordance with UFAC guidelines replace the existing inventory in the nation's households, deaths due to smoldering fires will decline. A potential eventual reduction approaching 40% of residential fire deaths is possible, although it will be a number of years before the effect is readily observed because of the relatively slow rate at which furniture is replaced in the home.

It bears repeating, however, that the smoldering scenario is the only one which can be effectively controlled by a simple ignition test because it is the only one in which the ignition source is closely tied to the kind of fire which develops.

### B. Resistance to Open Flame Ignition

Some modern furniture is composed entirely of synthetic materials having, for example, a fabric covering composed of a thermoplastic such as polypropylene and a stuffing of polyurethane. Such assemblies are more difficult to ignite with a cigarette than are furnishings of more traditional design having, say, a rayon or cotton cover and containing substantial amounts of untreated cotton batting in the padding. It has been suggested that modern furniture assemblies provide an extra risk of flaming combustion, occasioned by the plastic materials, which is not present in the cellulosic-based item. This possibility has been the principal reason a flaming ignition test, as well as a cigarette test, has been suggested. This approach has been proposed by the State of California, and by Olin Corporation, to the Consumer Product Safety Commission. The Center has recently undertaken an evaluation of the California proposal at the request of the Consumer Product Safety Commission.

Use of an open flame test would no doubt help eliminate those constructions which are prone to ignition from a small flaming source. Thus, a well-designed test has the eventual potential of eliminating some 7% of residential fire deaths. It is important, however, to recognize the limits, as well as the benefits of such an approach.

The most significant limit is the previously-mentioned fact that resistance to a small flaming source provides no assurance that the article will not be ignited by a slightly larger one. There have been a number of small open flame tests used in the past, notably the U.S. Department of Transportation Motor Vehicle Safety Standard (MVSS 302), and the specifications contained in Technical Bulletin 117 required by the State of California. In work done for the Washington Area Metropolitan Transit Authority in 1975, we found that bus seats which passed MVSS 302 would not ignite with one match but could be ignited by two. The effect of lighting a newspaper under seat material which passed MVSS 302 was the total involvement of the bus in fire in less than three minutes. It would be a mistake to say there are no differences between one small flame test and another--there are. However, there are also good experimental reasons to believe that any such test will be inadequate for prediction of material behavior at higher heat loads than the test conditions require.

It is unlikely that the 7% of residential fatalities which arise from small open flame ignitions of furniture represents the start of a big new problem attributable simply to foam plastics. Cellular materials, especially polyurethane, have been present in substantial quantities in practically all upholstered furniture (and a substantial fraction of the mattresses) manufactured in this country in the past 15 years. Modern furniture is sufficiently widespread, and has been in use sufficiently long that it seems reasonable that the present fire experience already reflects much (probably well over half) of whatever adverse impact is attributable to this scenario.

Perhaps as much as 28% of residential fire deaths are attributable to ignition of furniture by larger sources. It is possible to design a test which will identify such furniture, however we are unaware of any generally acceptable methods to produce residential furniture which will resist large ignitions and still be consistent with other consumer expectations such as comfort, durability and price. If appropriate materials were available, the cause of residential fire safety would be well served indeed.

### C. Control of Heat Release Rate

In our view, a more promising approach to the large source ignition problem is the control of heat release rate of furniture materials since it focuses on the rate of burning instead of the widely variable circumstances of ignition. Research is beginning to yield methods of predicting the development of unsafe conditions as a function of heat release rate. A simplified and idealized version of one of these was used to derive the data presented in Figure 1.

In addition, heat release has the potential for a continuous scale of risk assessment. Heat release rates can be determined for other residential components as well as furnishings, so that the contributions of all components to fire buildup can be compared and assessed. In the future, it may be possible to combine furnishings with restricted heat release rates with other fire protection measures, such as residential sprinklers, to provide a relatively fire-safe environment at minimum cost.

Research on methods of measuring heat release rate are well under way. It is expected that preliminary test methods, applicable to specialized furnishings such as institutional mattresses, will be completed this year.

Here again, however, material research has lagged behind. Industry has seldom attempted to produce cushioning materials having controlled heat release rates--in large measure, because the requirements to be met were unknown. It remains to be seen how well this challenge will be met once the guidelines for heat release are available.

## V. SUMMARY AND CONCLUSIONS

### A. Burning Behavior of Traditional and Modern Furniture

Although fire experience data are not sufficiently precise to shed any light on the overall relative hazards of traditional and modern furniture, laboratory observations suggest the following.

1. Where the furniture is made of traditional cellulose materials, it is likely to be ignited by a cigarette and continue to smolder through much of its burning time. Since this is inherently a slow process, the time to reach untenable conditions will be of the order of hours.

2. Where the furniture contains substantial amounts of cellular cushioning materials, such as polyurethane or latex foam, it is more likely to burn with an open flame.

3. Flaming fires produce untenable conditions much more rapidly than do smoldering fires; typically of the order of minutes.

4. Furniture constructed of modern cellular materials typically has heat release rates high enough to promote the onset of room flashover in many residential situations. Burning under flashover conditions reduces the escape time still further.

5. We know of no presently accepted technology for the production of synthetic cushioning materials of specified heat release rate or ignition resistance, except to small sources. We do not know whether this shortcoming is inherent in materials or whether the development of such solutions have never been systematically attempted due to the lack of good measurement criteria.

## B. Means of Material Control

The various ways in which furniture is involved in residential fire fatalities are summarized in Table 2. The important consequences of how furniture burns, coupled with the present pattern of fire loss, leads to the following conclusions:

1. The most common small ignition source in fatal furniture fire is the dropped cigarette. Preventing cigarette ignition is a potential means of preventing about 30% of all residential fire fatalities.

2. An open flame ignition test using a small ignition source, by contrast, would probably only control an additional 7% of the total.

3. If material control is desired to address the flaming furnishings problem, the route with the widest applicability is, in our view, the control of heat release rate. This has the potential for controlling 35% of residential fire fatalities beyond those avoided by cigarette ignition control.

TABLE 2

SUMMARY OF ROLE OF FURNITURE IN RESIDENTIAL FIRE FATALITIES

| Percent of Residential Fire Deaths | Typical Ignition Source | Mode of Fire Development | Means of Material Control |
|---|---|---|---|
| 31 | Cigarette | Smoldering Throughout<br>or<br>Transition to Flaming | Resistance to Cigarette Ignition |
| 7 | Match | Flaming | Resistance to Small Open Flame Ignition |
| 2 | Space-Heater | Flaming | Rate-of-Heat Release Control<br>or<br>Resistance to Large Ignition Source |
| 26 | Burning Wastebasket | Flaming | Rate-of-Heat Release Control |
| 66 | | | |

# EARTHQUAKE AND FIRE ACT AUTHORIZATION

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**THURSDAY, FEBRUARY 28, 1980**

House of Representatives,
Committee on Science and Technology,
Subcommittee on Science, Research, and Technology,
*Washington, D.C.*

The subcommittee met, pursuant to notice, at 8 a.m., in room 2325, Rayburn House Office Building, the Honorable George E. Brown, Jr. (chairman of the subcommittee) presiding.

Mr. Brown. The subcommittee will come to order.

This morning we continue with several days of hearings on the operations of the fire program, the National Fire Administration and the earthquake program.

We have already had witnesses from the agencies and covered their activities in considerable detail, and this morning we will have mostly outside witnesses who will comment on the programs from the standpoint of the user community, beginning first with the fire community.

Before we introduce the first witness, I would like to ask the distinguished ranking member if he has any comments he would like to make at this point, or would he like to reserve them for the witnesses from New Jersey.

Mr. Hollenbeck. I can reserve them until that time, Mr. Chairman. I will cast unanimous consent to insert my full text of comments into the record.

Mr. Brown. Without objection, so ordered.

[The material referred to follows:]

# OPENING REMARKS
## HON. HAROLD C. HOLLENBECK
## SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY
## February 28, 1980

Mr. Chairman, it is with great pleasure that I welcome our witnesses from the public today to testify regarding the reauthorization of the Federal Emergency Management Agency, and specifically, the U.S. Fire Administration which is among the various programs which comprise FEMA.

The purpose of the Federal Emergency Management Agency is to simplify emergency responsibilities and coordinate planning and response at all levels of government in the event of all types of disasters. FEMA is a new agency, recently created by Executive Order, to combine and improve our response capabilities to disasters -- natural, man-made, and war related. Of the agency's six program categories, we are especially interested in the programs of the U.S. Fire Administration this morning. Each year, losses due to fire are greater in amount than the sum total of destruction and life loss which results from flooding, hurricanes, and tornadoes combined. In a single day, fire claims the lives of 25 people; another 275 are injured; and $14 million in property damage results. Thus, the importance of fire prevention cannot be overstressed. In recognition of this fact, the National Fire Academy has been established with prevention, rather than fire suppression, is its aim. Nevertheless, there remains much for the Federal Government to do in assisting localities in fire prevention and disaster control as I am sure our panelists this morning will testify.

During these hearings, we must remember that, while FEMA invisions a partnership among Federal, state and local branches of government, in the final analysis it is the local level which is most important, for here the response to fire or disaster occurs. It is, therefore, essential that the Federal Government do all that it can to assist with planning response and recovery on the local level.

For this reason, we are particularly fortunate to have two local firefighters and chiefs of their municipal departments here to testify this morning. It is with great pleasure that I am welcoming Chief George Viccaro of the North Bergen Fire Department and Chief Robert Beyea of the Bergenfield Fire Department, both from my district in New Jersey. Together these two men bring to us a total of 37 years of firefighting experience, and both have risen among the ranks of firefighters to the position of chief of their departments. Thus, we have a unique opportunity to hear how U.S. Fire Administration programs effect and could possibly better local fire and emergency agencies in the field. Chiefs Beyea and Viccaro will be appearing as a separate panel and will offer the perspectives of both a volunteer and a paid fire department in New Jersey. At the same time, Mr. ~~George~~ Gordon Vickery, Administrator of the U.S. Fire Administration, is here to answer questions which the Committee may have or which are posed by the two chiefs. I am hopeful that we will have an opportunity for some direct interaction in questions and answers between the clients of the Federal agency and the Director of that Agency.

Chief George C. Viccaro of the North Bergen, New Jersey fire department recently completed twenty years of service with that department. He has risen through the ranks as firefighter, Captain and Deputy Chief, to his current position as the leader of a 120-man paid fire department responsible for the proteciton of 5.8 square miles of residential and commercial property and the lives of 55,000 people. Each year Chief Viccaro and his men respond to approximately 1800 calls for assistance, 1300 of which are actual fires. Under the Chief's successful leadership, the North Bergen department has earned recognition as one of Northern New Jersey's best departments.

In addition to Chief Viccaro's long-term experience at the scene of the fire, he has distinguished himself in fire-related tests and classroom performance. That George Viccaro ranked number one in the State on his Civil Service examination for the rank of Captain and number two in the State on the Deputy Chief exam evidences his knowledge of fire suppression and prevention techniques. Presently the Chief is devoting his off-hours to working towards a fire science degree.

An equally distinguished fire fighter and Chief of the Bergenfield, New Jersey volunteer force is Chief Robert Beyea, who joins Chief Viccaro on our panel this morning. Chief Beyea is a third-generation firefighter, whose dedication to this department began 17 years ago. During the years, Chief Beyea rose through the ranks to become lieutenant, captain, assistant chief, and finally chief of his department. In recognition of his outstanding service to his community, the members of his own department elected him Trustee of the Bergenfield Fire Department. In addition to his service to his department, Chief Beyea has served in various capacities

INCLUDING CHIEF, IN THE CIVIL DEFENSE FIRE-RESCUE SQUAD AND THE VOLUNTEER AMBULANCE CORP.

LIKE SO MANY FIRE FIGHTERS IN NEW JERSEY, CHIEF BEYEA RECEIVES NO MONETARY COMPENSATION FOR HIS EFFORTS. THE RESIDENTS OF ALL COMMUNITIES WHO ARE DEPENDENT UPON THE UNSELFISH PERFORMANCE OF VOLUNTEER FIRE DEPARTMENTS ARE, INDEED, GRATEFUL TO VOLUNTEERS SUCH AS CHIEF BEYEA FOR THEIR MANY SACRIFICES, AND WE ARE ESPECIALLY ANXIOUS TO HEAR THIS MORNING ABOUT THE NEEDS OF THE VOLUNTEER FORCES AND WHAT THE U.S. FIRE ADMINISTRATION CAN DO TO ASSIST VOLUNTEER FIRE FIGHTERS.

IN ADDITION TO THE REPRESENTATIVES FROM MY HOME DISTRICT OF NEW JERSEY, WE ALSO HAVE OTHER DISTINGUISHED WITNESSES INCLUDING OUR COLLEAGUE, DARPEL ANTHONY FROM ARKANSAS, WHO WILL TALK ABOUT THE TREMENDOUS POTENTIAL OF COMMUNITY MASTER PLANNING FOR FIRE PROTECTION AND CONTROL. WE HAVE MS. JANE SEIGEL OF THE AMERICAN INSTITUTES OF RESEARCH, AND MR. RICHARD SMALL FROM THE STATE OF OREGON, WHO CAN TALK ABOUT PUBLIC EDUCATION WHICH IS TREMENDOUSLY IMPORTANT AND ABOUT SOME SUCCESS STORIES THERE, AND I HOPE THEY CAN ALSO POINT OUT SOME AREAS FOR IMPROVEMENT. FINALLY, WE HAVE MR. ROBERT HERCHART, WHO IS THE CITY MANAGER OF FORT WORTH, TEXAS, WHO I HOPE WILL BE ABLE TO SPEAK TO US ABOUT THE SEVERE FIRE PROBLEMS IN THE SOUTHERN PORTION OF OUR NATION WHERE FIRE-DEATH RATES ARE SUBSTANTIALLY GREATER THAN THEY ARE IN OTHER AREAS OF THE NATION. I HOPE YOU WILL BE ABLE TO GIVE US SOME SUGGESTIONS AS TO HOW WE MAY BE ABLE TO IMPROVE THIS SITUATION.

MR. CHAIRMAN, I THANK YOU AND I LOOK FORWARD TO HEARING THE TESTIMONY TODAY AND WELCOME THE WITNESSES.

Mr. **Brown**. We are very pleased to have with us this morning Ms. Jane Siegel from the American Institutes for Research and Mr. Richard Small from the Fire Standards Accreditation Board of the State of Oregon.

I will not recite their lengthy qualifications in this field, but will insert the biographical data in the record at this point, and will welcome both of you here this morning.

Ms. Siegel, would you like to proceed, and of course, the full text of your statement will be inserted in the record if you choose to summarize or abbreviate it in any way.

Ms. **Siegel**. Thank you, Mr. Chairman. I would appreciate it if, in the interest of time, I could simply do a summary of the statement.

[The biographical sketch of Jane Siegel follows:]

Jane A. L. Siegel

American Institutes for Research
4614 Fifth Avenue
Pittsburgh, Pennsylvania 15213

Education: University of Colorado, B.A., Spanish and Latin American Studies, 1966
University of Virginia, M.Ed., Evaluation Research, 1975
Carnegie-Mellon University Currently Matriculated Doctoral Student in Public Policy Analysis, School of Urban and Public Affairs

Present Position: Consultant

I. PROFESSIONAL EXPERIENCE

*American Institutes for Research* (February, 1977-Present): Currently serving as a consultant for an AIR project, Capacity Building for Arson Prevention and Public Fire Education Programs. Her responsibilities include: (1) assistance in the design and data analysis of studies about community based arson prevention programs and residential safety survey projects. In the Spring of 1979, she directed an assessment of the capacity of state, local, and private sector organizations to respond to federal arson prevention and control initiatives. Previously she directed a study of multi-year program planning and evaluation of projects for OPE. As principal investigator for this grant, her primary tasks were to conduct a comprehensive review and analysis of program plans and implementation data from some thirty-five fire safety education projects involving secondary and post-secondary formal and informal programs, the fire service and community and volunteer organizations throughout the United States. Collection of evaluation materials in use and analysis of evaluation reports and recommendations for improved practices or procedures resulted from these efforts. Preliminary findings and their implications led to development of a program evaluation training effort for recipients of agency support.

Project director on a subcontract to the Bureau for the Education of the Handicapped (BEH), U.S. Office of Education, to conduct a study for Family Communications, Inc. and the National Center on Educational Media and Materials to assess alternative distribution patterns for a multimedia instructional series featuring Fred Rogers of *Mister Rogers Neighborhood*.

*Lewin and Associates, Inc.* (1974-1977): Consultant and Executive Secretary to the Study Review Panel for the National Center for Education Statistics (NCES) study,· National Survey of the Preservice Preparation of Teachers, primary tasks were to conduct research and prepare reports and communications for NCES, educational researchers, teacher trainers, and decision-makers in state and federal government who are concerned with teacher education.

*CONSAD Research Corporation* (1975-1976): Senior analyst for a study to develop self-evaluation methodologies for youth drug programs for the National Institute on Drug Abuse (NIDA).

Project director for a demonstration and research project on women in non-traditional blue collar careers for the U.S. Office of Education (MDTA-CETA) which involved five sites and tested approaches from recruitment through counseling, vocational training, placement, and follow-up of women.

*University of Virginia, Evaluation Research Center* (1972-1975) : Coordinator of a three-year external evaluation of four national pilot teacher center projects (in the Oakland/ Berkeley, and San Francisco, California and Washington, D.C. Public School systems and the Rhode Island and Texas State Departments of Education).

*Albemarle County Public School System* (1970-1972): Coordinator, E.S.E.A. Title I Migrant Program which involved preparation and implementation of the program proposal, selection of personnel and instructional materials, and coordination of education, health and welfare services for school-age migrant children.

Assistant to the Federal Programs Director, was a position in which she prepared numerous proposals for E.S.E.A., Title I, Title III, and Title VI programs. Also, she supervised personnel ordering and receiving NDEA Title II and Title III materials. Additionally, she authored a process evaluation of the E.S.E.A. Title I program.

Counselor, E.S.E.A. Title I Migrant Program which required academic and vocational counseling for migrant children as well as serving as the home-school liaison officer and interpreter for migrant families in the schools, health and local social service agencies.

*Boulder County YMCA* (1968-1970): Counselor, caseload of approximately 50 adolescents in a drop-out prevention program.

*Peace Corps, Washington, D. C. and La Paz Bolivia* (1966-1968): Administrative assistant to the Peace Corps Director/Bolivia and preparation of the Peace Corps.Bolivia PPBS plan for Peace Corps/Washington.

## II. CONSULTING EXPERIENCE:

International Paper Company Foundation, program assessment for the Education and Community Resources Program.

Far West Laboratory for Educational Research and Development, Women's Educational Equity Proposal Writing Workshop, trainer for sessions on Defining and Developing Goals and Objectives and Evaluating Project Methods and Results.

Institute for Educational Leadership, The George Washington University, to draft an annual evaluation report for their USOE sponsored Career Education Policy Project.

The National Advisory Council on Education Professions Development, to research and prepare an issue paper on Teacher Centers for use by the Council in determining their stance in this matter.

For the Evaluation Training Program for the Division of Personnel Preparation, BEH/USOE, to design and deliver assistance to personnel in Institutions of Higher Education to do process evaluation using the Discrepancy Evaluation Model (DEM).

For the Training Program for Early Childhood Experts, to evaluate their efforts in the Elkind Project, University of Rochester, Rochester, New York.

## III. PUBLICATIONS

*A Process Evaluation - Title I Project 002-71-1*, Albemarle County Public School System, 1972.

The Annual Report: *Evaluating the Four Teacher Center Pilots*, Vols. I, II, III, and V, Evaluation Research Center, 1973.

The Second Annual Report: *Evaluating the Four Teacher Center Pilots*, Vols, I and IV, Evaluation Research Center, 1975.

*Data Needs of Educational Decisionmakers about Education Personnel Preparation*, Lewis & Associates, Inc., and Evaluation Research Center, November 1975.

*Final Report, A Marketing and Distribution Plan for I AM, I CAN, I WILL*, Family Communications, Inc., and American Institutes for Research, August 1977.

*Multiyear Program Planning and Evaluation for Public Fire Safety Education*, American Institutes for Research, October 1978.

*Assessment of State and Local Capabilities to Respond to Federal Initiatives in Arson Prevention and Public Fire Education*, Final Report, American Institutes for Research, August 1979.

## STATEMENT OF JANE SIEGEL, CONSULTANT, AMERICAN INSTITUTES FOR RESEARCH

Ms. SIEGEL. My name is Jane Siegel and I have been doing program evaluation work for the past 10 years. There are basically two approaches that are usually taken. One is that experts such as myself develop evaluation designs, ways to determine whether or not programs are having impact and making change in the real world, and then do some measurement and look to see whether programs work or not.

A second, slightly less elegant, but I believe more effective approach, is for an expert to work closely with the users of the evaluation and to build their capacity and take into account their information needs in the development of designs.

We began in 1977 to work with the U.S. Fire Administration and what I would like to do briefly is describe the development of the evaluation and documentation effort to date, and describe a few projects where there is some evidence of program effects. Then I'll conclude by speaking a little bit about the Office of Planning and Education's efforts and the potential for using their activities in other emergency service and hazard mitigation areas.

The evaluation system, as I said, began in 1977. OPE the Office of Planning Education's mission was to build capacity at the State and local level, and so we began to work with representatives from about 25 fire departments around the country who were planning and beginning to implement programs at that time, and I'd like to use the overhead for just a moment now to display this information.

[VuGraphs shown.]

This is a systematic planning process which the Office of Planning and Education had adopted and had disseminated to the projects that they were supporting in the field. There were some 35 projects underway in 1977. They were familiarized with that material and they were basically following the first four steps—problem identification, program selection, development, and implementation.

When we went out into the field we found that when they started to talk about evaluation (the fifth step), they had neither materials nor methodologies to begin to measure program impact or even to document in a very straightforward manner what their programs were or were not doing.

After lengthy debate, we reached some consensus on some indicators of program impact. We had people who were interested in everything from measuring whether teaching children to stop, drop, and roll in their schools would stop burns from happening, to municipal managers who really wanted to know if they invested a certain amount of resource in a program whether they would see a loss reduction over time.

The four indicators that were developed and agreed on for impact measurement are: Institutional change, education gain, reduced risk and reduced loss. We assumed that there would be a continuum; that the institutional change would likely be seen first as a program began to be implemented and resources were allocated; that as people's awareness and knowledge increased, you could measure some education gain on the part of the public; that if you then proceeded to implement that program effectively, you should expect those people to use what they had learned and to correct hazardous situations and change their unsafe behavior; and that ultimately in the 3- to 5-year timeframe, you would hopefully see some reduced loss in terms of death, injury, and fire incidence and dollar loss.

OPE, as I said, had some 35 projects funded in 1977. There were seven types of programs. I am going to speak today primarily about two of them: Residential inspection and the resource network development programs.

In each of these programs, OPE is using what are called dissemination strategies that have been used previously in other fields such as agriculture and medicine to take new knowledge and technology and transfer it to the field and encourage its adoption and use to improve a given program.

When we began to look at program effects, we found two serious problems. One was that there were resource limitations and there were highly varied informational needs in the field. The other was that there was very poor quality base-line data for measurement over time about the impact of new programs.

We decided that the best approach would be to try to encourage the use of an evaluation system and, in trying out that material, we began first with a project USFA had supported, a smoke detector seminar program, where 9,000-plus fire educators were exposed to a training seminar to teach them about smoke detector utilization and ways to train others in proper installation and use.

AIR did an impact study, using a random sample of 200 participants drawn from a pool of about 5,000 of the people exposed to the seminar. In looking for overall training impact, we determined that each seminar participant ultimately trained about 175 people, and thus we were able to extrapolate that from the sampling universe we used, about 1.1 million people would have been reached with the information from the smoke detector seminars for a total Federal cost of about $90,000.

In the area of residential inspection programs, in 1979 there were 57 municipalities in 26 States sending civilian inspectors into residences to determine whether there were fire risks present and to educate people about correction of those risks.

I am going to talk briefly about four communities. Mount Prospect, Ill., began their program in 1976 when they had had a history of high-fire incidents. A survey of the community for education gain following one year of their program's implementation showed that 704 out of the 1,000 study participants, or 93 percent of those individuals gained some new knowledge and information about fire safety.

In the community in 1976, 58 percent of their fires were of a residential variety. In 1977, the communitywide fire incidence level for residences increased to 60 percent of the total, but, in fact, just two fires occurred in homes that participated in the study, or 0.04 percent of the total fire incidence for that year.

There are case studies in progress now in seven sites. The first one visited is Aurora, Colo., where 2,500 homes in a targeted high-fire incidence area were inspected during 1978–79, and it was found that during the year following the initial survey, citywide fire incidents increased by 21.1 percent. Fire incidence, however, decreased by 4.5 percent in the target area.

We have reports from Memphis and Tucson, two other sites to be included in the current case study effort but not yet visited; that in the case of Memphis, there was a 20-percent decrease in fire incidence during the year following their home safety project, and in Tucson, there was more than a 50-percent decrease in fire incidents.

The data that are available, while far from ideal, suggest that residential inspection programs really are effective in reducing fire risk and loss to the public. Concomitantly, they do provide meaningful employment for CETA workers and older Americans.

The resources have not been available, however, to sustain the programs over time or to do a thorough evaluation of program impact.

In the case of State public education programs, which is the Office of Planning and Education's major activity for building a resource network in the States, there are 15 States currently involved. They basically try to foster adoption and use of new knowledge and technology through a series of strategies including: materials production and distribution; training people who in turn train others; providing information and resource exchanges; and disseminating exemplary program information.

There is a great deal of institutional change evidence available in the 15 States. For example, virtually all of them have had reallocation of physical space to provide housing of resource centers. They have assigned State and local personnel specifically for public fire safety education outreach activity. Also they have harnessed private sector support from major insurance companies and all the hamburger chains in the country for printing of fire safety education materials.

Thus, for about $20,000 per State of Federal seed money, OPE has stimulated the field to improve public education and reduce risk and fire loss ultimately.

Another promising initiative is juvenile fire-setter counseling. In Los Angeles County, a study was done from 1972 through 1974 showing that there was a decline from 169 cases of juvenile fire setting to 12. That trend has been sustained over a 6-year time period. In Upper Arlington, Ohio, where they had a 10-year record of cases of 360 youth treated, there have been only 11 repeat offenders.

There are some new OPE programs that are being implemented. They are: arson information management systems for arson prevention and control, master planning, and emergency medical services.

Because OPE's network frequently involves fire educators who have responsibility at the local and State level for other emergency service programs, there is a high potential for transferring both information and the evaluation methodology to the field using OPE's network.

The potential for these people to have an effect at the local level is greatest because the fire service is the one major public service that is still in neighborhoods all of the time.

That completes my summary.

Mr. Brown. Thank you very much, Ms. Siegel.

[The complete prepared statement of Ms. Jane Siegel follows:]

# STATEMENT OF JANE SIEGEL*
# CONSULTANT
# AMERICAN INSTITUTES FOR RESEARCH
# BEFORE THE
# SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY, U.S. HOUSE OF REPRESENTATIVES
# FEBRUARY 28, 1980

My comments today focus on the evaluation system developed to document and measure the effects of public fire safety education and arson prevention programs. First, I'll describe the systems' creation and implementation. Then, I'll provide a brief summary of evidence of program effectiveness for specific fire safety education projects. My concluding remarks will address the potential use of Office of Planning and Education programs in coordination with other emergency services and hazard mitigation efforts.

In the Spring of 1977, I was told by the U.S. Fire Administration (then NFPCA) officials that Public Fire Safety Education is happening in the U.S.A.; that there was solid evidence that the number and quality of education programs is increasing and improving at a rapid pace. Furthermore, there were some initial impact data and recent research findings which strongly supported the assertion of the authors of America Burning that public fire education programs result in a measurable reduction of fire incidence and loss.

At the state and local levels, however, no assessment of the capabilities or information needed to measure the effects of public fire safety education programs was done. During the Summer of 1977, I began a study of USFA sponsored projects to determine the resources available and practices in use for program evaluation. Concomitantly, a formal review of evaluation methodologies (especially of health education and public education programs) was undertaken. In July and August, I visited: Hopkinton, Mass.; Chicago and Mt. Prospect, Illinois; Oklahoma City, Oklahoma; Salem, Oregon; Seattle, Washington; and the California communities of Covina, Los Angeles County, Orange County, and Santa Ana. In each site four factors were assessed: personnel available, nature of data system, interest in program evaluation, and use of data currently collected.

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*The comments contained herein are solely my own and do not represent those of the American Institutes for Research.

This experience confirmed that effective Public Fire Education programs were underway where major fire problems were identified and a community had the capacity to plan and implement efforts targeted at its particular fire problem. Using the OPE systematic planning approach, Fire Chiefs along with their staffs and concerned community members completed early steps of selecting an education program based on an analysis of: 1) resources to be organized and used; and 2) fire problem data. Prior to education program implementation, this baseline information was reviewed and stored for use in the determination of program impact. The general situation, however, was that no designs, procedures, or materials (instruments, forms, or examples) were available to carry out evaluation of these promising programs.

Given OPE's primary mission to increase the capacity of the state and local fire service communities to reduce fire loss in the U.S.A., we proposed and they supported a project involving The American Institutes for Research. This was done with the assistance and cooperation of the Fire Service in some twenty locales to design mechanisms and/or materials to meet these needs for the fire community. The system to document and evaluate Public Fire

Safety Education and Arson Prevention programs was developed in 1978-79. Five manuals entitled The Effectiveness Handbooks for Fire Educators were developed. These "how to" manuals are designed to help fire safety educators improve their programs and present evidence of program effectiveness. The five volumes are:

Volume I - Overview addressing the reasons for and ways to demonstrate program effects;

Volume II - Communicating Program Results providing suggestions for ways to prepare and present information about program effects;

Volume III - Effectiveness Through Public Education Assistance Programs offering methods and forms specifically tailored for State Public Education Assistance Programs (PEAP);

Volume IV - Home Safety Survey Program addressing documentation and evaluation for residential inspection projects; and

Volume V - School Programs providing evaluation designs to measure the effects of formal school-based fire safety education efforts.

Thus, fire educators may use Volumes I and II plus any one of the additional volumes for a targeted program or may use the whole set if they are implementing a series of public education programs. There are technical appendices also, which detail methodologies for one and two group designs; pre-post test methods; time-series analysis; analysis of variance and other measurement techniques in plain English. Field tests of this series will be completed by AIR in June, 1980.

To date approximately 3600 sets of The Effectiveness Handbooks have been distributed through workshops where documentation and evaluation skills have been taught to fire educators by trained consultants from state and local fire agencies. Thus, the materials developed with the users involvement, are being adopted while the capacity of the field to teach their peers has been built.

Early in the development of the materials, a key conceptual step was the agreement reached on indicators of program effectiveness. Effectiveness can take many forms: a department increases its education budget; a child learns to stop, drop and roll; a family purchases a smoke detector; the rate of kitchen fires decreases. The indicators of effectiveness specified in The Effectiveness Handbooks for Fire Educators are:

- Institutional Change;
- Educational Gain;
- Reduced Risk;
- Reduced Loss.

The logic underlying the indicators is that change usually happens on a continuum with four phases or stages: (1) resources are made available to start a new fire safety education effort (Institutional Change); (2) a program is implemented and people's awareness and level of knowledge are increased (Educational Gain); (3) people correct potentially hazardous situations (Risk Reduction); and (4) the effects of these changes may be fewer fires, reduced dollar loss from fire or fewer fire related injuries or deaths (Loss Reduction).

Examples of each kind of change will be provided as I summarize some evidence of program effects. The program areas are: smoke detectors; residential inspection; Public Education Assistance Program (PEAP); Juvenile Firesetters; and Arson Prevention.

The USFA Smoke Detector Seminar Program

Most U.S. fire deaths occur in residential dwellings during the nighttime hours. Most deaths are caused by smoke rather than burn injuries.[1] Recent research indicated that smoke detectors have the potential of reducing loss of life from residential fires by 40%. To help achieve this reduction in loss of life, the USFA's Office of Planning and Education and the National Fire Academy developed a Smoke Detector Program to educate the fire service in methods for increasing public awareness. This meant increasing consumer awareness that detection devices for residential fire protection exist; encouraging residents to purchase a smoke detector; and instructing them about correct placement and maintenance of these devices.

The USFA program involved development of five Smoke Detector Manuals, dissemination, and training of fire service leaders through Smoke Detector Seminars. Ninety-three seminars were conducted in 35 states throughout the U.S. in 10 months (September, 1977 - June, 1978). A trainer aided by local and state fire service leaders delivered a three hour long training session on smoke detector utilization to 9,567 participants. AIR later conducted a study of the impact of these seminars using a random sample of 200 from among a pool of 5056 conference participants. On looking for the overall impact of the training, AIR determined (with a statistically weighted average) that 175 persons were ultimately trained by each seminar participant.[2] Thus, the individuals (from the sampling universe) who attended the seminars are estimated to have trained about 1.1 million individuals in the use, installation, and maintenance of smoke detectors. About 174,000 of these 1.1 million were fire service personnel while approximately 884,800 were members of the public.

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[1] NFPCA, U.S. Dept. of Commerce, Smoke Detector Fact Sheet, 1977.

[2] Smoke Detector Seminar Study, American Institutes for Research, September, 1978.

The total cost of the training effort was $90,431. Development and initial production of the manuals and brochure cost approximately $80,000. Thus, for about $170,000, OPE has been able to provide smoke detector information to almost a million citizens and to provide training to a large number of fire service personnel. A conservative estimate[3] of the incidence and loss reduction resulting from the smoke detector seminar program was made using the best available data. It was estimated that 175,405 fires would be prevented, saving 30 lives, 1056 injuries, and $34,500,000 in dollar losses to U.S. citizens.

Residential Inspection Program

Fire departments in 57 cities in 26 states were inspecting homes to identify and correct fire hazards as a result of OPE efforts as of August, 1979. These inspections are designed to eliminate hazards in the home and thus reduce fire risk and incidence. The surveys are conducted using senior citizen and CETA (Comprehensive Employment and Training Act) personnel as community fire educators.

Initial reports of effective programs came from Edmunds,[4] Washington and Mt. Prospect, Illinois. In Mt. Prospect, as with most projects Institutional Change came with the addition of

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[3] "The Costs and Benefits of the Smoke Detector Seminar Program," Frank Morra, Jr., September, 1978.

[4] AIR received data from Edmunds, but discontinuation of their residential inspection project in 1977 impeded further study of that site.

7 civilian (CETA supported) employees for the fire Department. The local Boy Scouts of America, Lions' Clubs and Kiwanians provided support for printing of educational literature and garnering public access for the program. A community poll, to measure Education Gain was conducted with 704 of 1000 residents responding. Results showed that 93% of the residents who participated in the program learned new fire safety information. A total of 2,938 residential surveys were conducted over nine months and 9011 hazards were identified in Mt. Prospect's single-family residences. Whereas the 1976 fire incidence in three residences was 58%, just .04% (2 fires) occurred during 1977 in homes that participated in the inspection.[5] A cursory analysis of 1978 and 1979 incidence data will be done during 1980 to measure the sustained impact of the residential inspections. Unfortunately, CETA or other resources have not been found to continue this program nor to support a formal study of risk and loss reduction in this or other residential inspection projects.

There are a set of case studies in progress which examine program accomplishments in Aurora, Colorado, Fresno, California, Huntington, West Virginia, Memphis, Tennessee, Miami, Florida, Sumner County, Tennessee, and Tucson, Arizona. Preliminary data about fire incidence in Aurora, Memphis and Tucson suggest that these home inspection programs have had measurable impact in terms of reduced fire incidence. Aurora, Colorado's program staff inspected 2572 homes and contacted 6138 persons during 1978-79.[6] Fire incidence data show that Aurora experienced a city-wide increase of 21.1 percent (1076 calls), but a decrease of 4.5% (29 calls) in the target area where inspections were conducted. Also, Fire Department officials distinguished fire incidents on the basis of "preventability" - that is, whether the victims of the fire could have taken reasonable steps to prevent the accident from occurring. Since these were the incidents the project was most interested in preventing, an examination of these incidents provides the clearest indication of impact. Between February 1 and December 31, 1977 there were 72 "preventable" fire incidents in the target area. In 1978, during this same period, the number of these incidents had dropped to 22 - a decrease of 69.4 percent.

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[5] Mt. Prospect Home Safety Survey Project Evaluation Dept., July, 1978.

[6] Case Study Report: Aurora Colorado Home Safety Advisory Program (Draft), American Institutes for Research, February, 1980.

In Memphis, initial data from the fire department show a 20% annual decrease in fire incidence was experienced from 1977 to 1978, in the target area where home inspections occurred. The target area was a high loss residential section of the city. Similarly in Tucson, 7115 homes were visited over ten months and the Fire Department reports that building fires decreased from 1977 to 1979 by more than 50% in areas of the city participating in the program.[7]

The data available suggest that the residencial safety inspection program is an effective way to reduce fire risk and loss to the public while providing meaningful and worthwhile tasks for CETA workers and older Americans. Without resources to support evaluation of the impact of these programs on their respective localities so this information can be made available to local,

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[7] Memphis and Tucson will be studied during the spring of 1980 by AIR. Case study reports will be prepared, including careful analysis of fire incidence data.

best copy available

state and federal decision-makers, residential inspection programs may be curtailed before their case is made.

State Public Education Assistance Program

OPE's Public Education Assistance Program (PEAP) began in 1977 with the involvement of four states and presently involves 15 states to develop and improve access for local fire educators to programs, materials, training, and technical assistance by building a public fire education network. In this initiative, OPE is employing strategies previously used in the fields of medicine and agriculture to promote use of new knowledge and improve public education programs. Among the original four sites, a lot of Institutional Change has occurred with state and local public funds. This support has taken the form of physical space reallocation to house resource centers; involved assumption of printing costs to support production of resource catalogs and newsletters; and included funding for professionally developed materials from the private sector, e.g., The Hartford Insurance Group, Burger King, Burger Chef and MacDonalds. Most important, all of the 15 states have formally reassigned personnel to duties for public fire education. Estimates based on PEAP states' documentation indicate states are investing four dollars for every one dollar of federal support. Thus using a small amount of federal seed money ($20,000 per state) OPE has stimulated the field and changed the quality and quantity of resources available to state and local fire educators.

Other OPE Initiatives

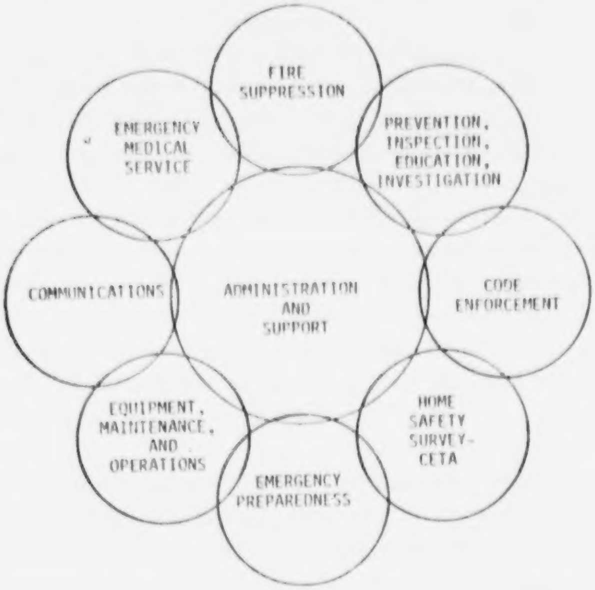
OPE has invested small amounts of it's FY'80 funds to support four promising programs in 1980. These are: (1) Counseling Juvenile Firesetters; (2) Arson Information Management Systems; (3) Master Planning; and (4) Emergency Medical Services. In each case, OPE selects promising demonstration efforts based on available effectiveness data and delivers new knowledge and technology thru it's resource network to the field.

For example, some three years will be required before we can definitely determine the outcomes of Counseling Juvenile Firesetters. Yet, we know now that fire department education, counseling, and referral programs have shown impact in Los Angeles County, California where the incidence of this problem dropped from 169 cases in 1972 to 20 cases in 1973 and 12 in 1974. In Upper Arlington, Ohio, a study of their Juvenile Firesetter Counseling program showed that of 360 youths treated, only 11 (3%) were repeat offenders over a ten year period. The investment of $35,000 federal dollars to make an outstanding locally developed program available nationwide is worthwhile. And we will know what the impact of the Juvenile Firesetters program is, because part of the package and the on-going technical assistance is to document and evaluate each project. Likewise the Arson Information Management Systems projects of OPE's Arson Prevention Program are under study to determine feasible evaluation designs and to ensure systematic documentation of efforts to develop arson information management systems in seven model sites supported during 1970-80 by USFA.

Initiatives in the fields of Master Planning and Emergency Medical Services (EMS) are logical extensions of OPE's modus operandi too. Locally developed projects in these program areas along with other hazard mitigation services have shown promise. Master Planning products and expertise for improved municipal services, especially fire, are being brought to bear in ten communities favoring systematic, comprehensive public sector planning processes. About 60% of the 30,000 Fire Departments in the U.S. are providing Emergency Medical Services (EMS). Fostering improved EMS practice through an information exchange bulletin OPE reached some 4000 people during 1979 using its fire education network. An example of the expanded role of fire educators, who address the gamut of emergency service at the local level is shown in Exhibit I. Given local level organizations like Mount Prospect's, it seems feasible that the OPE resource network could effectively engage in complimentary coordination of a range of related efforts to improve current practice and build local capacity. While estimates of the effectiveness of the four OPE initiatives are clearly premature, the prognosis seems positive, largely because of the unique OPE/USFA fire education network. The fire educators in this network occupy a special, effective position in educating their local citizenry because the fire service is the one public service that's still in the neighborhoods.

EXHIBIT I

The Fire and Emergency Department is comprized of eight (8) service areas designed to provide a safe environment for the residents of Mount Prospect by the delivery of a systematic Fire and Emergency Service with all eight (8) components supporting and complimenting each other. These eight (8) service areas are depicted as follows:


FIRE SUPPRESSION
PREVENTION, INSPECTION, EDUCATION, INVESTIGATION
EMERGENCY MEDICAL SERVICE
COMMUNICATIONS
ADMINISTRATION AND SUPPORT
CODE ENFORCEMENT
EQUIPMENT, MAINTENANCE, AND OPERATIONS
HOME SAFETY SURVEY-CETA
EMERGENCY PREPAREDNESS

# SUPPLEMENTAL STATEMENT
# OF JANE SIEGEL
# TO THE SUBCOMMITTEE ON
# SCIENCE, RESEARCH, AND TECHNOLOGY,
# U.S. HOUSE OF REPRESENTATIVES
# MARCH 7, 1980

## Evaluation of OPE/USFA Projects

OPE presently supports 15 state-wide projects carrying out the Public Education Assistance Program (PEAP). To determine the effects of the 15 projects, i.e., to test for changes in education gain, risk reduction, or reduction in loss of life and property associated with PEAP implementation in these states, resources earmarked for this purpose are needed.

Funding in two forms will be required. First, each state will need approximately $5000 per year for three years to ameliorate evaluation activities of a PEAP person such as costs of: evaluation materials (forms, checklists, etc.); intra-state communication; travel; data analysis; and report preparation. Also, the $5000 would be sufficient to support participation in evaluation training programs for a PEAP fire educator each year, to build that state's capability to do on-going program impact studies.

The second form of support would be for training and technical assistance in program evaluation for the PEAP states. As noted on pages 3 and 4 of my previous testimony, initial planning and evaluation skills are being taught to fire educators by trained consultants from state and local fire agencies. To complete modifications to training workshops and provide support for this peer teaching activity, approximately $75,000 for FY81 and $40,000 for FY82 will be required.

One example of a critical problem which would be addressed through sustained support for evaluation activity is described below in greater detail than was provided in my statement before the Subcommittee.

An inhibiting factor in determining the effect of Office of Planning and Education, USFA programs is the lack of accurate baseline data on fire incidence, cause, and loss. The National Fire Data Center efforts have improved data quality in some local and state jurisdictions. Until computer access or acquisition becomes much more prevalent, however, data collection and analysis in many local and state sites involves tedious, manual activity. Also, most departments involved in fire safety and arson prevention projects lack the resources to train personnel responsible for fire incidence reporting. Furthermore, there are no apparent rewards for the officer who prepares an accurate fire incidence report (having just suppressed a fire and being exhausted from this activity in many instances). Several progressive fire chiefs have identified this problem area and noted that entering "garbage" into the system results in getting "garbage" out, but they lack the resources to change the situation.

The Office of Planning and Education, USFA has been stimulating and supporting PEAP sites to do data collection for use in systematic planning and program effectiveness determination. To alleviate the problem noted above, PEAP fire educators could serve as effective linkers in: (1) communicating the importance of accurate data to the local fire service community; and (2) providing incentives to carry-out this data activity well.

Why don't you go ahead, Mr. Small, and then we'll ask questions of both of you.

## STATEMENT BY RICHARD SMALL, DIRECTOR, OREGON STATE FIRE STANDARDS AND ACCREDITATION BOARD

Mr. SMALL. All right, Mr. Chairman.

I have some overhead transparencies I would also like to show to help display what's been happening in Oregon in the last 3 or 4 years.

First, I would like to say a few words about myself. I entered the fire service in 1955, and the last seven years have been the director of the Oregon Fire Standards and Accreditation Board. Prior to that, I spent 6 years in the State fire marshal's office, and I'd like to clarify that the State of Oregon feels that a very balanced system—those of enforcement, suppression, and protection—are very important to the State's fire protection system.

Oregon has not always experienced a low fire loss. They've had loss considerably above the national average, and just until recent years. Just recently we have experienced a marked reduction in the total loss, the percapita loss, the numbers of incident, and also a premium reduction, which is important.

Another interesting thing about Oregon is that about a third of its loss has occurred in rural areas. That is, what are considered ISO or insurance service office's ratings of 9 or 10. That is very remote, very rural, and contributes, I believe, one-third of the loss in Oregon.

Now, that's property that's outside the metropolitan areas. It's outside almost any kind of fire protection that you can consider a normal level.

Oregon is a young State in relation to what we see on this coast. It's 2.5 million population, growing rapidly; it's sparsely populated, 22 people per square mile, and most of those live in the Central Valley, so that leaves wide open spaces. Long travel distances create a feeling of rugged individualism, and this frontier spirit and the reputation for innovation seems to affect the delivery of fire services.

People resist the Federal Government or State government coming to their communities. They are generally unaware of what's happening, and, furthermore, they don't really care. They are busy with their lives.

In 1973, the fire standards board was created to generally help the fire departments do a better job. They are broadly representative. They work directly for the Governor, and they were established to help develop a system that would provide reasonable fire safety at a reasonable cost and to use innovative ways.

Shortly thereafter, the U.S. Fire Administration—then the NFPCA, or National Fire Prevention and Control Administration was created. The goals and objectives were much the same as those of the fire standards board, and this tended to create an interest in the board to look at more innovative ways and progressive procedures.

This led to involvement in the public education assistance program, or PEAP, and we have reaped tremendous benefits from those programs.

Justified or not, I mentioned that the fire service does resist, and for that reason, the board had the philosophy that the best place for these problems to be resolved were at the local level, where those making the decisions were those that contributed to the problem. So all of the programs in the fire standards board are designed for that purpose; that they be developed, decisions made in the local communities.

This philosophy means placing the responsibility back in the hands of those contributing to the problem, and that's very difficult for us to do at times.

PEAP supports this approach. The State provides the innovative leadership, provides the systems coordination; we provide technical assistance; we have people that help the local communities do their planning; we have information exchange and we provide resources.

The Federal program or the national program has helped us through the same things, leadership, stimulation—they kind of nudged us along and got us going on some programs that had been beneficial. They have provided us with resources, and more importantly, resource exchange so we can exchange ideas with other States. They have provided us with technical assistance; they have helped us measure our results.

What were the benefits of PEAP to Oregon? I guess probably one of the most important things was the organizational design, and I'll show you that just very briefly in a moment to show how that affects us.

I think the resource exchange with other States and within our own State has been a very important asset to us.

They helped us to develop a planning process. That's where we can specifically identify not only the statewide problems but where communities can look at their own local problems and design programs to meet them.

As a result of their assistance, we created a "mini-grant" system, where we give $500 grants to local communities if they will agree to do a planning process. Also, we now develop programs that are focused on statewide problems such as smoker's carelessness, misuse of flammable liquids, and more recently, the solid fuel heating applicances.

We make those available through a resource exchange system that are resource centers across the State, so within a reasonable driving time—generally just a few minutes—anyone interested in delivering public education can pick up the programs and use them. And they are being used.

The mini-grant system or program has probably been one of our most effective. An example of that is Seaside, Gearhart, Cannon Beach. It's kind of a consortium between three small communities to take a look at their problem. It's a good example of some of the things that are happening. It's a community that's made up primarily of older people with an extremely high population in the summer. It's a coastal city—a resort city.

They had a 27-percent reduction of incident as a result of their activities. Primarily with smoke detectors in the homes for the elderly and the handicapped. Being a retirement home, that seems to be their most serious problem. They actually purchased the smoke detectors. The fire department places them in the home, and maintains them. They remain the property of the city and when someone no longer needs the smoke detector, it's relocated in someone else's home.

Another example might be Warm Springs. Warm Springs is an Indian reservation that had practically no fire protection or any interest in fire protection for the past years. With a $500 mini-grant, they were able to take a whole new look at their entire system and revamp the whole system, including smoke detector programs, increased training, et cetera.

Many of these places emphasize smoke detectors. Some of the activity through awareness programs, education, and schools, have created a climate and more interest in public education, therefore, smoke detector laws can be passed more readily and have an effect on loss.

Recently, all rental occupancies are now required to have a smoke detector, and any time a private dwelling changes hands a detector is installed as a part of the rental agreement in the rental facilities.

With that, I would like to show you some of the things to show just more specifically what the figures are doing.

[Viewgraphs shown.]

First, I mentioned—I don't want to go in this in too much detail, but the Oregon fire prevention pilot education program developed a system by which the State level has its role and the community has its role, and it closely tied together by the programs delivered by the fire standards board. Technical assistance, resource exchange, awareness conferences, model programs, eductors' tools, community action grants, the resource centers, are all focusing in on the community level.

That's the system that's worked and it's signed off by over 40 different interests in the State and supported strongly. They feel it's their program.

We use this design—Jane spoke of this—and in particular, I would like to touch on the identification step and the selection step and use an example.

In the Rogue Valley project—the Rogue Valley is a small community, very rural, intermingled with timber. They have a cooperative group that looks at fire problems. And they tried to select their most serious problem and identify what was causing the most alarms on the Rogue Valley project. As an example, they looked at incendiary fires, they looked at children playing with matches. They looked at debris burning. Finally, what they settled on as their most severe problem was man-caused fires, and using a chart, they were able to pinpoint that 13 percent of those fires were caused by boys 10 years old and younger, and so the target was boys 10 years old and younger.

Now, the program has had a fallout in other areas, but to give you an idea of what happened is where they had 15 fires with boys 10 years old and younger. They were the next year dropped to two. There are probably a lot of variables that could be taken into consideration, but this is what happened in this case and what happened in case after case.

One of the things when we first started with the Fire Standards Board, we tried to make some projections in our limited way. This was when we first started. We took the trend of fire loss in the State of Oregon, where it was going, not ajusted for inflation, just where it was headed. Not adjusted for population growth, and we drew a blue line and we were going to try to keep loss below that level in spite of anything.

So far, we are right on target. The next year, 1979, was in the same area with about a $47 million loss.

More specifically, we might look at some of the things that happened. The dollar loss in millions—as you can see, the unadjusted dotted line—has escalated and soared, except in the last several years there has been more fluctuation. If you correct it and adjust it, you will see that there has been a reduction in 1976 and 1977. This does not take into consideration that there has been a quarter-of-a-million population increase and considerable increase in value-at-risk.

Per capita dollars loss, again is coming down. The board was established in 1974; we began some activities in public education almost immediately; then in 1976, we began our effective relationship with the public education systems program.

As you can see, the adjustment loss is down considerably.

Again, the solid line showing the population increase in relation to the fires for 1,000 population and again since 1974, there is a continued reduction in fires per 1,000 population.

The total fires as reported by fire departments—again, this does not take into consideration of growth, nor does it take into consideration of increased value-at-risk—which has been continuing to drop since 1975, 1976, 1977, 1978; 1979, looks like it's about the same.

Fatalities—it's been a little slower in response, but again, that probably relates to the public education effort that came in 1976. You see the last two years it's dropped—actually that figure has been corrected to 69.

Another important issue is the cost of fire insurance. We just recently came across these figures and they haven't been developed thoroughly, but in July 1979, some significant rate changes—as provided by the ISO—affected Oregon. In Portland, there was 2.3 percent reduction in commercial fire rates. In the entire State, there was 17 percent; 8.9 percent reduction in extended coverage; and 13.6 percent in overall reduction.

Idaho has a variety of changes here, but resulted in 5 percent reduction in extended coverage, and 8.6 in overall reduction. Washington at that time—and still—has not received any significant reduction. They do expect some minimal change.

We havent't been able to calculate just what this means in dollars in the State of Oregon. I know if you take the neighborhood grocery store and reduce their fire premium by 17 percent, and then you compound that by all the other grocery stores and commercial buildings in the State, that's one pile of money.

We feel that these programs that we've been able to implement have given us sufficient history to show that there is a reduction as a result of some of the activities through public education.

We feel that much of this came through the stimulation from very small grants from the U.S. Fire Administration. And we probably look at the cost or the need by States to do these kind of things is probably $15,000 per State per year.

Finally, one more significant thing. Oregon has been faced with a severe tax revolt. You are probably aware of it. They have a limitation on positions, yet the Governor—actually, two Governors and the legislature chose to fund these programs. They funded them with people; they funded them with program development, because they looked to be the most cost-effective way, and they did move the processes to the lowest level of government.

That's what's happening in Oregon.

[The complete prepared statement of Richard Small appears as follows:]

# A REPORT ON
# FIRE PREVENTION EDUCATION
# IN OREGON

Presented by Dick Small, Director
Oregon State Fire Standards and Accreditation Board
February 28, 1980

Over the past four years, Oregon has experienced a marked reduction in fire losses.

- While the total population increases, total fire incidents are rapidly declining.
- In spite of extreme inflation, total unadjusted dollar loss is down.
- More importantly, loss of life has been cut almost a third.
- Every year fewer Oregonians are experiencing the anguish of losing their personal possessions which may have taken a life time to accumulate.

Oregon has not always been in an enviable position with respect to fire. In fact, our losses were considerably more than the national average and, of course, you know how we stack up with other nations.

We are a very large state—the tenth largest in the union. Yet, with a population of about 2.5 million, our density is a very low 22 people per square mile. A variety of life styles is keenly recognized within the state. Great distances (as much as 450 miles to population centers) make it difficult for people to get together and contribute to a feeling of "rugged individualism". However, this frontier spirit and the state's general reputation for innovation inevitably effects many aspects of our lives, including the delivery of fire protection services.

In 1973, the Fire Standards and Accreditation Board (FSAB) was created by the state legislature. It is a broadly representative participative management body with direct responsibility to the Governor. Its mission is to reduce needless injuries, life loss, and property damage occurring as the result of fire.

About that same time, or shortly thereafter, the U. S. Fire Administration (then called the National Fire Prevention and Control Administration) was created as the national focus on fire. The goals and objectives of the organization were very much in tune with those cited by the Oregon Fire Standards and Accreditation Board, and inspired the Board to look to even more innovative and progressive programs to address the rapidly growing fire problem in our state. And this led to our involvement in the Public Education Assistance Program (PEAP) through the U. S. Fire Administration, Office of Planning and Education. Over the past three years, Oregon has reaped tremendous benefits from the program.

Justified or not, constituents at the local level view government-mandated or sponsored programs somewhat skeptically. There is a resistance when we try to interfere, to do for them, or provide solutions to their problems. The fire service is no different. In fact, Oregon firmly believes the fire problem can best be resolved locally through joint efforts of fire protection interests and the community itself. This philosophy means placing this responsibility with decision-making authority back in the hands of the people who are contributing to the problem. As local communities tussle with finding solutions to fire problems, it becomes an educational process in itself. This exercise promotes increased awareness and reduced apathy about fire.

The Public Education Assistance Program (PEAP) supports this approach by working through a state-focused program. The state provides administrative leadership and systems coordination, technical assistance, resources and information exchange, all with emphasis on helping local communities to better plan, implement, and evaluate fire safety education programs for the public. In Oregon, the PEAP program has been the key impetus for establishment of a statewide delivery system for public education, initiation of a resource delivery and exchange network, development of an annual school, which offers specialized training for public educators, production and distribution of model fire safety education programs, and distribution of 20 community action grants. These grants promote citizen involvement in systematic planning for public education programs at the local level.

With respect to impact, the community action grant program is very effective. As an example, the community of Seaside, Gearhart, and Cannon Beach (located on the western Oregon coast) received a $500 grant. Through a citizen planning committee, they developed a program aimed at providing smoke detectors for the elderly and handicapped. Combined with other public education activities and participation in the state PEAP program, their fire incidents were reduced 27 percent within the next year.

Because the cost-effectiveness of such programs could be shown, and because positive results could be documented and evaluated, Oregon's program is now fully institutionalized in state government through General Revenue funding. Not only can we report reductions in the number of fires and per capita dollar loss, we can also report savings to the public.

Oregon is now receiving a significant reduction in commercial fire insurance rates (13.6 percent overall).

2.3% fire
8.9% extended coverage
11.2% reduction (City of Portland)

17.0% fire
8.9% extended coverage
25.9% reduction (Balance of State)

Idaho has received a small reduction; Washington, none. Oregon has, by far, received the largest reduction of the three states.

Programs similar to PEAP is what Oregon wants. It gives us structure, overall objectives which focus us toward a common goal, special help when we need it, but still remains flexible for states to mold individual programs based on its unique needs and available resources. Lastly, it compliments and supports our role as a state function rather than competing with or undermining our efforts.

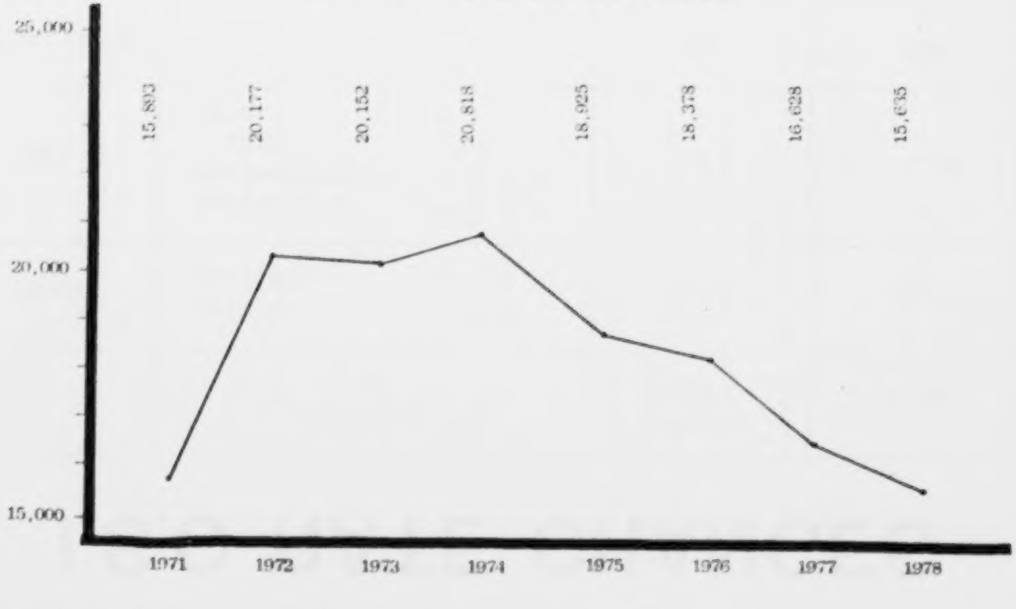
# I.S.O. RATE CHANGES

| | COMMERCIAL FIRE | EXTENDED COVERAGE | OVERALL |
|---|---|---|---|
| OREGON | PORTLAND = - 2.3 %<br>ALL OTHER = -17.0 % | -8.9 % | -13.6 % |
| IDAHO | MANUFACTURING = +5 TO 10 %<br>NON-MANUFACTURING = -5 TO 25 %<br>CHURCHES = +10 %<br>AUTOS = +7 % | -5.0 % | - 8.6 % |
| WASHINGTON* | NONE | NONE | NONE |

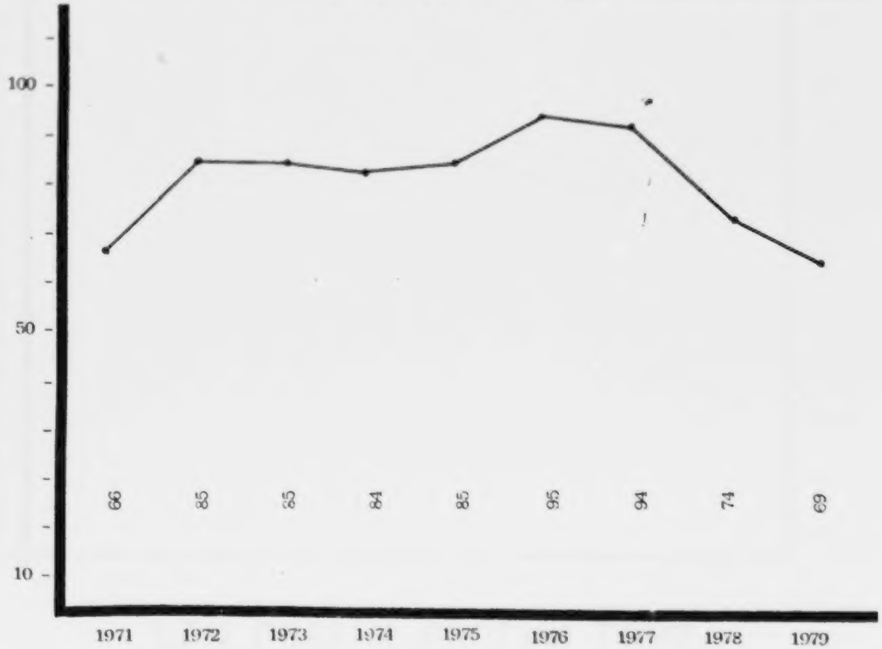
* WASHINGTON EXPECTS SOME MINIMAL RATE REDUCTIONS IN CERTAIN CLASSES

EFFECTIVE DATE: OREGON--7-1-79
IDAHO --10-1-79

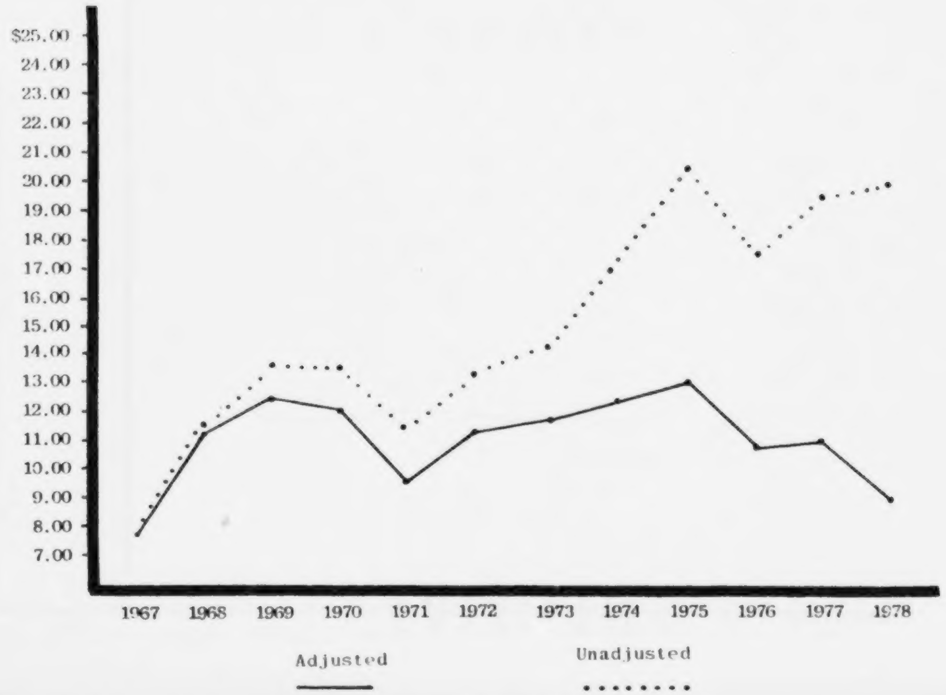
# TOTAL FIRES AS REPORTED BY FIRE DEPARTMENTS

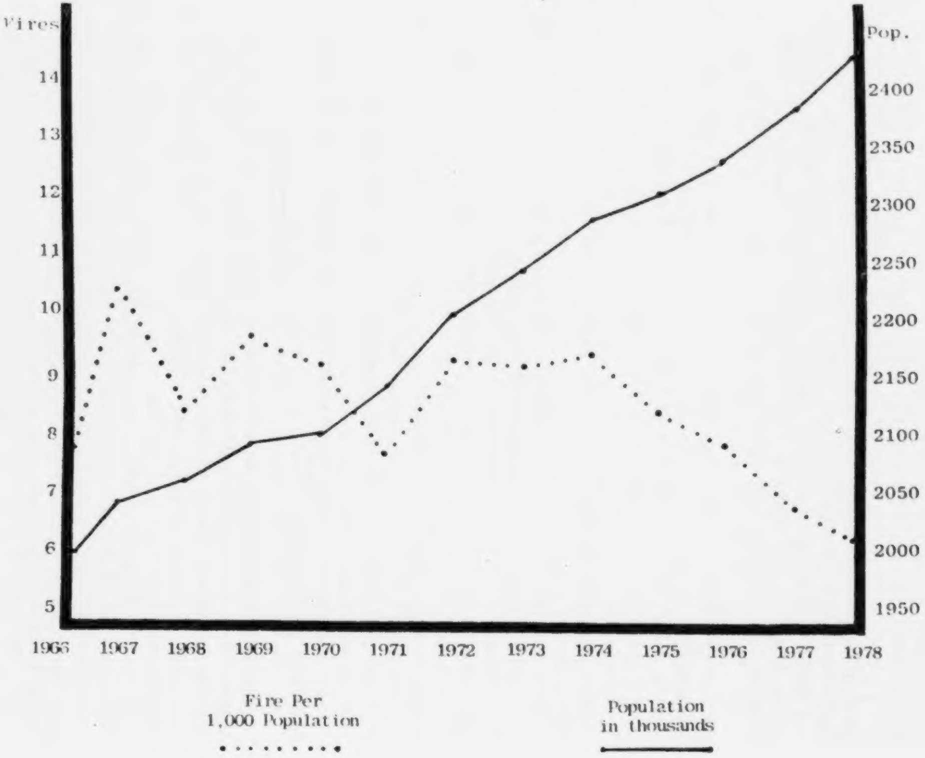


# FATALITIES


100
50
10
66
85
85
84
85
95
94
74
69
1971
1972
1973
1974
1975
1976
1977
1978
1979

# PER CAPITA DOLLAR LOSS




Fires
14
13
12
11
10
9
8
7
6
5
Pop.
2400
2350
2300
2250
2200
2150
2100
2050
2000
1950
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
Fire Per
1,000 Population
Population
in thousands

Mr. **Brown**. Thank you very much, Mr. Small.

Mr. Small, it is a little striking that these very small grants that you have mentioned should trigger the kind of resources at State and local level that you have indicated. Can you explain in a little more detail just how that happened?

I have difficulty in conceiving that a $500 grant would create that much impetus, but maybe I'm misjudging the situation a little bit. I would like to have you elaborate on it a little, if you would.

Mr. **Small**. Well, we were certainly skeptical when we tried it to start with. We had no idea what would happen. I guess one of the things that we tried to tie to the grant was involvement of people.

One of the first things, in receiving that kind of a grant——

Mr. **Brown**. That grant has to be applied for.

Mr. **Small**. Yes.

Mr. **Brown**. So that starts the process that indicates an interest, then.

Mr. **Small**. Yes. A very simple, one-page application. Actually, one- or two-page. Mainly a sign-off that a lot of people will be involved; that the public will be involved; that the fire service will be involved; the League of Oregon Cities; the schools, educators, businessmen, insurance industry; policymakers as well as the implementers become involved as a community project.

I think another thing is the involvement with the State and the involvement with the national programs gives some feeling of being a part of something big.

Mr. **Brown**. Is there a requirement for State or local matching funds in some proportion?

Mr. **Small**. No. We don't require any matching funds.

An interesting thing in the Seaside project—and in most of the cases—they do not spend the $500 in the first phase. We have what we call two phases. One is our planning phase, you know, identification and design of programs, and phase two is implementation and evaluation.

Most of them do not spend the $500 in the first phase. In fact, Seaside was so keyed up about this, they didn't spend any of the money, and they thought about giving the money back so we could give it to another community. They have not spent their money yet. They still have it.

Mr. **Brown**. If you could just stretch that so they would give back twice as much——

[Laughter.]

Mr. **Small**. Right. With interest.

Well, it seems to be the way that the communities' effort works—the same thing occurred with Warm Springs. The Warm Springs Indian Reservation had been customarily working with large sums of money. They are not poor. They were indifferent to the fire problem, but they are not poor people. They have been very innovative in making use of their timbered lands and the resort area.

The thing that impressed them is that folks in the community could make decisions that affected the community without a lot of strings attached to it, and they became very involved in it, and the committee is still operating, still working with no additional funding.

Mr. **Brown**. I'm still not clear just what that money goes for. Is it educational materials?

Mr. SMALL. Well, when it was first started that they would use it for postage, spending money to get started, and then in the second phase, we'd give them another $500 they could use to develop the program they were going to implement.

We do provide funds through other sources, $500 for other kinds of public education programs. All of the communities have asked—that have progressed into stage two—if they could use their first $500 for program development. Now that's where they're using the money, but it was primarily just set there for mailings, stamps—that kind of money.

Ms. SIEGEL. Mr. Chairman, I might be able to clarify a bit. In most public education programs, the variety that the U.S. Office of Education or other Federal agencies run, about 80 percent of the expense goes to personnel, manpower. And one of the surprising and refreshing things in working with the fire service has been to find that if you give them the money for the extras—materials development, xeroxing of papers and phone calls to bring people together for a conference, or to put together a newsletter—they will put in the extra time, so you are not paying personnel costs. I think that's one of the key factors in the low cost of these demonstration effects.

Mr. SMALL. They're all volunteer groups. None are paid. No pay at all.

Mr. BROWN. Ms. Siegel, we have been having some discussions in this subcommittee with regard to research in the social and policy sciences. It's an area which is subjected to frequent criticism in Congress because it doesn't seem to partake of the same glamour that the hard science research has, and yet one of the more promising areas of social policy science research is in the area of evaluation research which you have described.

I am wondering what conclusions we can draw here with regard to the importance of this field, and I would like to ask you to comment on it a little bit, since this is the area that you have specialized in. Is this an area in which there is some growth and development in the scientific capabilities? Are we, in other words, developing a sound scientific base here—a procedural base—which we can point to, and can you indicate from your experience that this can improve the planning and direction of not only programs in, say, the fire area, but in other areas where modification and organization, procedures, and activities can lead to savings or benefits or reduction of risks that we can compare with the cost of these things?

In other words, I am trying to apply a scientific, evaluative process to what you are describing here.

Ms. SIEGEL. Let me comment very briefly on the state-of-the-art in evaluation. It has certainly grown immensely since the middle 1960's when the Federal Government began to require a great deal of information from those that they funded. It is an improved field certainly, if we separate area of education or social science research from evaluation.

You can do experiments in a "hard" science situation where you have a great deal of control over what occurs. Clearly, in social situations, it is much more complex and much more difficult to control what's going on in the field. Many early evaluation efforts did not do well because they used research methodologies adopted from controlled behavorial experiments and focused too early or narrow questions and measured the wrong aspects of programs. One of the reasons that the approach that is being used here has some promise is that the overall planning process helps people to define the specific treatment they are going to impose; describe what conditions were prior to imposition of that treatment; and if those programs are implemented for 3 to 5 years, and there is support to measure program effects for the same kind of time frame, we can begin to go beyond correlational studies—studies which simply show that there is some strong relationship between implementation of one of these programs and the reduction in fire risk or loss—to actually show causal relationships.

I would not want to defend the state-of-the-art in my field in terms of stating what is always possible, but I do think that there is more promise in this case, primarily because of the interest of the program participants and because of the concrete nature of these fire safety education programs.

In the case of the residential inspection programs in particular, because you have very specific hazard identification, you should be able to go back in and see whether those physical hazards have been removed and so, determining a causal tie should be possible.

There are some specific opportunities where we (evaluators) should be able, using the best available approaches, to come up with some fairly concrete evidence of impact in fire safety programs.

In terms of their applicability in other areas, again, to the extent that you have a clearly specified hazard situation and you have some base-line data that tell you what is out there in the real world before you begin, and you have a 5-year period of program implementation and careful data collection over that time frame, I would say that the same sort of methodology ought to be applicable.

Mr. **Brown**. In other words, you would recommend that any program—public education programs or other types of programs aimed at alleviating the problem, reducing a risk—should be accompanied by a component providing for some scientific form of evaluation of the results of the program.

Ms. **Siegel**. I think if the Government at whatever level, local, State, or Federal, ever wants to know whether all these programs are making any difference, that's probably the only way they would do it. To know whether the changes are occurring because of chance, they would need to have that much of a time frame in order to really look at patterns and determine whether the program is causing a change, or whether there is some other factor involved.

Mr. **Brown**. There's an interesting example of evaluative research in the morning paper, having to do with the expenditure of quite a large amount of money to provide jobs for hardcore unemployed. Reading it quickly, it seemed to me that they assert that it was a successful program for welfare mothers, but for juvenile delinquents and dope addicts and so forth, it wasn't successful. They must have conducted some evaluative research in order to make those kinds of statements, I would assume.

Ms. **Siegel**. I presume so.

Mr. **Brown**. Let me ask Mr. Hollenbeck if he has any questions.

Mr. **Hollenbeck**. Mr. Chairman, I have a question in—maybe not quite a different frame—but along the lines you speak of in terms of residential inspection program and the reduction of risk on a day-to-day basis.

I noticed in your testimony, Mr. Small, you alluded to the fact that there had been a substantial increase in the fires in the rural areas in Oregon. Is that correct? And I think somewhere along the line in testimony—or I read recently—that there has been a similar increase in Vermont.

As many of us have noticed, there has been an increase in the number of woodburning stove and the use of wood-burning stoves and that type of apparatus because of the high fuel prices. I wonder if, in your opinion, there is any correlation between that increase in that type of fire, and just what can be done on a day-to-day basis to reduce that potential hazard and to police—I know there are local regulations, zoning codes, ordinances, and the like, but how practically do you police something like that?

Mr. SMALL. Excuse me, your last sentence—"police that"?

Mr. HOLLENBECK. Police. Well, oversee compliance with the local ordinances and zoning codes. I imagine it would be quite a problem.

Mr. SMALL. From a standpoint—well, let me say first that we are, in the State of Oregon, grappling with that subject right now. We have a substantial increase in the number of incidents caused by heating appliances, generally installed by people not qualified, nor does anyone even know that they are installed, or how they're put in until the time that the fire occurs.

They go out to a local store, buy it, take it home and put it in, nobody even knows it.

Mr. HOLLENBECK. I have one myself.

Mr. SMALL. Installed the same way, right?

Mr. HOLLENBECK. I followed the literature, but——

Mr. SMALL. Probably that's a good example, though, of the problem with fire in Oregon and probably the Nation, is that people are not aware of the hazards they are creating, and they are more interested in saving some money and doing a more efficient job of heating their home.

Our approach to that right now is that people do not want to create a hazard for their life and their property, and if they are aware of the problem, they will correct it.

We intend, and are in the process of implementing, specific, targeted public education programs in rural areas. We are going to do that through the granges, the extension service, and on two pilot studies we are going to run in a rural area where elderly people will actually make home safety surveys and go in and consult with the farmers generally, and the ranchers. That's how we intend to do it, through education.

As far as meeting building codes, I don't think we will be able to do it.

We did find that we have an extreme increase—this was through a rather extensive study—where there is an extension or a population growth increase of 5 percent into unincorporated areas, we have a 50-percent increase in incidents, That's probably because as more people move into those areas, they're not accustomed to the problems that exist and the things that they are developing, and there is no one there to help them at all. We are trying to move into those areas and thereby reduce our incident. That's the interface with the rural timbered lands.

Mr. HOLLENBECK. Thank you.

I think that's an interesting example, Mr. Chairman, of recognition of an emerging problem. I would be curious to see or to know what some of the other areas—some of the other states—are doing about that problem.

Mr. **Brown**. Let me just conclude my one question.

You both indicated some rather significant aspects of the problem of reducing fires through public education in this country. I'd like to know if you have any recommendations as it would apply to the program of the Fire Administration.

In other words, based on your experience, what do you think that Congress should do in terms of enhancing, decreasing, changing, the role of the Fire Administration as it affects the programs you have described?

Ms. **Siegel**. I have two comments. One is to the extent that both authorization and appropriations can occur to support the public education programs for a sufficient time frame so that you can determine their effectiveness, I would think that that would be very important.

The other point is that for the State public assistance programs that are operating, it would seem to me that an expenditure of about $20,000 per year in each of the 50 States, if it begins to bring about the kind of loss reduction evidence that one sees in Oregon or some of the other participating States, would be a very good Federal investment. You are talking about $1 million plus the administering costs. That would not seem to me a huge expenditure for that kind of a return.

Mr. **Small**. From a standpoint of Oregon, where we have been quite heavily involved in public education and the entire fire protection system—not just that area—one of the real difficulties we have on a statewide basis is evaluating what's happening in Oregon. Being very scientific about it and very systematic and being able to prove which programs are working and which are not.

We've had a great deal of help in this area and can now show whether we have had an impact on a specific problem.

From a standpoint of other States, and I am aware of the situations in many of the States in that they need the same kind of help and I believe they are asking for the same kind of help, that's innovative programs that stimulate and help them to make their own decisions. Again, we had approximately $10,000 one year and $20,000 the next year, or about $15,000 per year, which was very, very meager to try to do the things we were doing, and didn't really do the job, and we supplemented it with a considerable amount of money.

But in that, $20,000 to a State could do the same things that it did to ours, and of course, the other funds that are required to administer those programs in the Federal system that we think would be appropriate.

Mr. **Brown**. All right. Thank you very much, both of you, for your testimony. It was very helpful to us in getting a perspective on this whole problem.

Our next witness will be Mr. Robert Herchert, city manager of Fort Worth, Tex.

Mr. Herchert, we are very happy to have you here this morning, and if you have a prepared statement, it will be inserted in the record, and you may proceed to present it in any way that you wish

## STATEMENT OF ROBERT HERCHERT, CITY MANAGER, FORT WORTH, TEX.

Mr. **Herchert**. Thank you, Mr. Chairman. It is pleasure for me to be here today to address your committee.

My name is Robert Herchert, and I am city manager of Fort Worth, Tex., a community of about 400,000 people located in the north central Texas area. We have a number of suburban cities in our area, including the city of Dallas, which is located about 35 miles to the east.

Prior to coming to Fort Worth, I worked for 4 years for the city of Kansas City, Mo., where my primary responsibility was to oversee the development and implementation of the fire protection improvement plan for that city.

Before Kansas City, I worked as city manager for a rural Arkansas community; I understand the committee has a particular interest in that part of the country.

Mr. **Brown**. One member of the committee, at least.

Mr. **Herchert**. Yes, sir, that's what I was told.

I was recently asked by the International City Management Association to be its representative on the Fire Department Organization Committee of the National Fire Protection Association; also, the International City Management Association asked me to serve as a member of the committee a few years ago that was appointed to assess the transferability of the fire master planning process developed by the Fire Administration.

Again, I understand the committee has a particular interest in the subject of fire master planning.

Because the time is so limited, I would like to offer a few brief comments on several items which I understand you have an interest in, and then try to amplify if you desire.

The first area I would like to talk about is the general state of the fire service today and the role of the Fire Administration in improving the situation as it exists.

In my opinion, the fire service of this country remains tradition-bound, archaic, resistant to change, oriented to fire suppression rather than fire prevention, lacking in innovation, is union-dominated and lacks management.

I make this statement——

Mr. **Brown**. You're going to get more critical as you go along. [Laughter.]

Mr. **Herchert**. I make this statement with the full understanding that much progress has been made in the past decade, and in particular, since the publication of "America Burning" in 1973, the report of the National Commission on Fire Prevention and Control.

That report challenged the fire service in many, many ways. However, in my view, nearly all of the challenges contained in that report remain.

For example, the Commission stated that firefighter productivity must be increased, quote, "Not for the sake of productivity alone, but for the public safety. The time to get on with it is now," end quote.

I submit that little has been accomplished in this regard since 1973.

The Commission also noted that—quoting again—"The easy answer is to augment the budgets of fire departments by 20, 30, 40 percent, so that more equipment can be bought and more firefighters hired, but it does not follow that increases of 20, 30, 40 percent will be matched by like reductions in losses of life and property, nor is it realistic at a time when most local governments are financially squeezed to speak in such terms.

"A more realistic solution for most communities lies in careful assessment of what future investments, whether of men, equipment, or new programs, will maximize effectiveness and a gradual shift of priorities toward the most cost-effective measures." End of that quote.

As I indicated earlier, I had the privilege of working in Kansas City, Mo., from 1974 to 1978, and was deeply involved in that city's attempts to improve firefighter productivity, to emphasize fire prevention, and to look for cost-effective ways to provide fire service.

In short, that city is attempting to follow the advice contained in "American Burning."

What we found in Kansas City was that fire stations were located according to tradition by, as a matter of fact, how far a horse could run before he tired out; that working hours were influenced by tradition, using the 24-hour-on, 48-hour-off concept. That tradition started when firefighters worked over 100 hours per week and were forced to live in fire stations.

That equipment was purchased and manned according to tradition; that the fire department was dominated by the local union, and that the only management person in the fire department was the fire chief; that well over 95 percent of the fire department's resources were committed to fire suppression, rather than fire prevention. It took a careful analysis of that situation to develop a plan to deal with those issues.

We did that, and as a result of that plan, a number of new stations were built which were properly located and sized, replacing a number of the smaller, improperly located stations.

Equipment was purchased which matched the needs of the city. We find that, traditionally, in most large city fire departments, only a very few incidents which the fire department responds to require more than, say, 25 gallons of water per minute. However, we traditionally send huge pieces of equipment which are capable of pumping 1,500 gallons of water per minute.

One of things we did in Kansas City was to install much smaller two-man vehicles—which were purchased and located throughout the city.

A new hourly work week, five 8-hour days, was instituted to allow for differential manning of stations and equipment by time of day and location, all according to need just as we do with the police service or any of the other services we provide.

This new work schedule eliminated the need for sleeping in fire stations. The entire work day for each firefighter could be productive instead of one-third of his time being productive.

We greatly increased the emphasis on fire prevention, public education and training. Building inspections, residential, commercial, and industrial inspections were conducted by line firefighting companies.

A management development program was instituted for district chiefs and deputy chiefs who previously saw themselves as chief firefighters, not fire managers. The union-led resistance to these changes I have described was massive and continues.

I recite this story of the efforts of Kansas City to indicate the kinds of problems which exist in nearly all fire departments today, and the magnitude of changes which need to be made if we are to meet the challenges presented in "America Burning."

Changes and challenges of this magnitude require significant commitment and support from the Federal Government; therefore, I would urge you to continue your support of the Fire Administration in a number of areas.

One, in making data available to cities and helping cities understand fire problems better. We absolutely need national and local data if we are to know what kinds of changes should be made within our fire systems.

Two, related of course to the availability of data is the program of the Fire Administration in fire master planning. This planning process, in my opinion, has the potential to make a significant impact on the fire problem of this country.

Three, helping cities develop local public education programs and conducting national public education efforts. We must try to make people of this country more conscious of fire prevention and fire safety.

Four, the research activities of the Fire Administration regarding new technologies, equipment and innovations the work of the Fire Administration in developing firefighter protective gear is a good example of what can be done in this field, and is a significant step.

Five, the development of a management cadre of persons in the fire service. The Fire Academy can make a significant impact in developing true fire department managers and professionalizing the fire service. We need fire officers who can see the big picture; who can see the benefits of increased emphasis on fire prevention and public education; and who understand the need for change and how to manage change.

The committee—through your staff—expressed an interest in the regional problems of the South and, in particular, the causes of the high fire death rate in this area.

I don't pretend to be an expert on this subject, but I would suggest a few factors which I believe contribute to this problem.

We have in the South an unusually large number of small cities, small towns, which traditionally lack a good fire department, lack building codes, minimum housing codes, fire prevention codes, and fire prevention activities in general. Partly as a result of this lack of code enforcement, we have in these smaller cities many more substandard housing units per capita, which are typically of frame construction and highly susceptible to fire.

I believe we have a less-aware public, possibly because of the socioeconomic characteristics of the population, and possibly because of the lack of a strong public education program.

A recently completed study of the Fire Administration showed that heating problems lead to more fire deaths in the South than any other single cause. That's not the case in other regions of the country. I think these deaths result in large part from a lack of awareness on the part of the victim of the danger that an improperly utilized space heater or other makeshift heating device can present.

Related to this concern about the high fire death rate is the concern of the committee and the Fire Administration as to why Southern States are not participating in the national fire incident reporting system.

I would speculate that the causes for this lack of participation are: No. 1, the fact that we have rural-dominated legislatures whose members are not convinced of the need to collect data about urban fire problems, and who resist appropriating funds to support this activity; No. 2, that we lack professional staff at the State level who understand the need for and benefits of such data; and No. 3, that the Fire Administration has failed to develop a local base of support for this State activity.

I believe the soon-to-be-appointed regional representatives of the Fire Administration can be very helpful in developing such local support. I suggest that the Fire Administration garner the support of State municipal leagues, city managers, mayors, fire chiefs, and other local related fire organizations in order to secure state participation.

Finally, the committee expressed an interest in the degree of coordination which should exist between the Fire Administration and other subunits of the Federal Emergency Management Agency.

In my view, the Fire Administration should never have been included in FEMA because of the underlying orientation of the Fire Administration should be preventive rather than reactive. The Fire Administration must be concerned about the many small fires which take place every day which take the vast majority of lives and property.

The long-term answer to the fire problem is not going to be found by discovering ways to put out fires better and faster, but by preventing them. The other subunits of FEMA react to major disasters. Plans for reaction to such large disasters are not, in my opinion, similar in any way to the fire master planning concept which should be proactive and preventive in nature.

Mr. Chairman, that concludes my prepared remarks. I'd be happy to answer any questions.

Mr. **Brown**. I thank you very much, Mr. Herchert, for your statement which is indeed challenging and provocative and contains a great deal of very sound advice and guidance, which, as I am sure you are aware, would not be necessarily widely accepted even in Congress, but nevertheless is useful.

Mr. Hollenbeck?

Mr. **Hollenbeck**. I was just curious, Mr. Herchert, who would react to these large-scale disasters such as earthquakes, hurricanes, if it were not the local fire department?

Mr. **Herchert**. Absolutely. They have to react to those large-scale disasters, and there is a role for the fire departments of this country to play any time we have a large disaster, and they must work hand-in-hand with the subunits of FEMA and the other city agencies who are involved.

My point wasn't that. My point was that the master planning process of the Fire Administration is very different than the plans which have to be made to respond to that kind of disaster. We need those plans as well, but the master planning process as developed by the Fire Administration is really that; it's much more of a process than it is a plan. It should be a management tool for trying to improve the fire situation within a given community, and that's a different animal than a plan to respond to a disaster.

Mr. BROWN. Well, may I ask, Mr. Herchert, if the same philosophy you are expressing with regard to the fire service, namely, one that's aimed at prevention, amelioration—at least in part—cannot be applied to a number of other kinds of emergency situations. For example, many communities have conditions which are a high-risk condition in terms of chemical spills, for example, or some other things. In other words, poorly planned transportation, poorly planned traffic flows, a number of things that by adequate, comprehensive emergency master planning—general emergency master planning—might be alleviated in the same way that fire master planning will alleviate the fire risk.

Mr. HERCHERT. Yes, sir. I think there is some similarity there. However, I think there are also some major differences. Again, in my view, the job of that fire master planning process is to look for ways in which we can shift more of the burden from the public sector to the private sector for built-in fire protection devices. It includes the things that you have been talking about such as smoke detectors, built-in alarm systems, built-in extinguishing systems. It includes a much stronger emphasis on day-to-day preventive activities by people out doing something on day-to-day basis.

I think that's the key difference that I'm trying to articulate, that it is an ongoing process, whereas in planning for a major disaster, once a plan is developed that pretty well completes that process.

Mr. BROWN. Well, I don't want to belabor this. I think your emphasis is correct, but I also think that, for example, in California, we would benefit from an improved planning and education process to deal with—let's say—earthquakes, because they are fairly common out there.

Mr. HERCHERT. Absolutely. I've had some experience with natural disaster problems, such as the flood that we had in Kansas City a few years ago, and you need plans to deal with those terrible disasters, and I couldn't agree with you more.

Mr. BROWN. Your statement conveys a tone of pessimism about the prospects for change in the fire service, and I recognize there's some basis for that. But may I ask you, if the very fact that we have created the National Fire Administration and have the beginnings of a public education program and a research program and a number of other things of that sort, all with the support of the fire professionals and the union, doesn't it indicate a willingness to recognize that change is in the offing, and that they'd like to see desirable change come to their profession?

Mr. HERCHERT. Yes, sir. I think they are all very positive steps, and I don't want to convey a pessimistic attitude. On the other hand, I know from my own experience, we in the fire service are hampered by, constrained by, local and State laws which greatly impair our ability to utilize our personnel in the most productive way; to promote the most qualified people into these positions; and that we need, I think, to look at this as a long-term problem which, over a long term, will require massive change.

I am not suggesting that we can do that overnight, and I believe that the steps that have been taken by the Fire Administration to date have been very positive, and that we've made a significant amount of progress since 1973. However, in my view, a whole lot more remains to be done.

Mr. Brown. Mr. Herchert, we have some time pressures, so I am not going to keep you any longer.

I think you have made a very useful contribution, and we would like to be able to call on you in the future for assistance to the committee if you could be available to do it.

Mr. Herchert. Thank you, Mr. Chairman. I would be.

Mr. Brown. I'd like to call now Chief George Viccaro—if I pronounce it right—and Chief Robert Beyea. If they were from California, I'd know how to pronounce it, but they're from New Jersey. [Laughter.]

I'd like to call on my distinguished colleague from New Jersey, Mr. Hollenbeck, to say a few words at this point.

Mr. Hollenbeck. Mr. Chairman, yes I'd like to welcome the two chiefs here this morning from two fine municipal departments in my congressional district, and two of the finer departments in New Jersey.

Chief Viccaro is the chief of the North Bergen Fire Department. Chief Beyea is the chief of the Bergenfield Fire Department. They have between them nearly a total of 40 years of firefighting experience, and both of them have risen from the ranks of firefighters to their present position. I think this gives us a unique opportunity to hear how the U.S. Fire Administration programs affect and can possibly better local fire and emergency agencies in the field.

They, of course, are going to offer their perspectives, both of a volunteer department—that's the Bergenfield department—and a paid fire department, that's the North Bergen department.

Just as a brief background, North Bergen has approximately 6 square miles of residential and commercial area, and is inhabited by some 55,000 people. Chief Viccaro and his department experience approximately 1,800 calls for assistance each year, 1,300 of those being fires.

Bergenfield is not that much smaller than North Bergen, having some 32,000 inhabitants and experiences a similar call ratio. I think, Mr. Chairman, in the interest of time, we can let both Chief Beyea and Chief Viccaro elaborate on some of the problems that they face and on their experiences with the Federal agency.

Mr. Brown. We certainly will. We are very pleased to have both of you gentlemen here this morning, and your experience in the fire field and relationship with the other program would be very helpful to the committee.

Do you want to proceed, Chief Viccaro?

## STATEMENT BY CHIEF GEORGE VICCARO, NORTH BERGEN FIRE DEPARTMENT, NORTH BERGEN, N.J.

Mr. Viccaro. Mr. Chairman and members of the subcommittee, let me start by saying that the Federal Emergency Management Agency has long been overdue, and is most welcome by the North Bergen Fire Department.

For too long the fire service has been the forgotten element of public protection, having been thought of by many as only a necessary evil. There has been no direct funding. What little funds that were received have been piggybacked through on other appropriations, such as law enforcement.

Ironically, the truth being, the fire service inevitably becomes the first line of defense in almost any situation that endangers the public. Whether it be a major fire, general disaster, or a riot, the fire department is saddled with the responsibility of bringing it under control.

The fire service needs help, direct help, and it needs it in all areas. The local governments can no longer bear the financial burden alone. The fire service can no longer be pushed aside.

The staggering statistics on loss of life and property, on arson—the fastest growing crime in America—coupled with the fact that firefighting is the most hazardous occupation in the country, mandates that the fire service be given the recognition, authority and funds commensurate with other emergency services.

A good example: arson.

Everyone in the fire service was aware of the tremendous problems it presented for years, but until the Federal Government recognized it as such, publicized it, and made funds available for arson detection and prevention, we in the fire service had a difficult time getting anyone in law enforcement to assist in the smallest way.

Now that there is funding, everyone, including prosecutors, are jumping on the bandwagon. I do not mean to imply that this sudden interest is not welcome; I just use it to demonstrate how effective Federal assistance can be.

Funds must be made available in all areas of fire service. The Federal Government must encourage the small departments to coordinate and standardize services and equipment, as already recommended in federally funded studies. This can be accomplished by funding regional training facilities, fire prevention and detection programs, arson squads and facilities, equipment and coordinating communications, and alarm systems.

It comes down to the reality that the above recommendations are an absolute necessity, but are economically infeasible for each department to finance, man, and maintain its own facilities.

Our local problems and our ability to provide quality protection and prevention comes down to money.

The small departments have all they can do just to provide adequate fire extinguishment. The cost of equipment has all but made special services and equipment impossible.

The governing body of North Bergen, for instance, made a firm commitment to the fire department, and has, in the past several months, undertaken a program to adequately man and update equipment. They appointed nine new firefighters to the Department, purchased a completely new radio system, and purchased three new fire engines. This equipment and manpower were badly needed, and could only be accomplished by floating bonds and placing a heavier burden on the taxpayers.

I have generalized a very serious problem which faces all the fire departments throughout the country, and I'd welcome any specific questions on it.

Mr. **Brown**. All right, Chief, thank you very much.

I think we will have your statement, Chief Beyea.

## STATEMENT BY CHIEF ROBERT BEYEA, BERGENFIELD FIRE DEPARTMENT, BERGENFIELD, N.J.

Mr. BEYEA. I would like to state that I consider it an honor and a privilege to appear before this subcommittee here today.

As was previously stated, I am a volunteer chief from New Jersey. The municipality in which I serve has a population of over 32,000 people. I have under my supervision 90 volunteer firemen and 4 paid drivers who work Monday through Friday, 8 a.m. to 5 p.m.

The apparatus in my department consists of four engines, two trucks, and one rescue.

During the calendar year 1979, the Bergenfield Fire Department answered a total of 440 alarms. Of these 440 alarms, 251 were answered by the entire department, and 189 were responded to by one company.

The total amount of volunteer man-hours in answering these alarms was 6,459 hours. Training and schooling during the year totaled 7,789 man-hours.

I have been asked to testify as to the needs of the volunteer firemen as it relates to the Fire Prevention and Control Act. The facts that I will bring forth will be those faced by many fire chiefs, whether volunteer or paid.

Through the Fire Prevention and Control Act, Congress has established a National Fire Academy. I feel, however, that many fire chiefs do not fully understand the main focus of the academy. So far, my knowledge about the academy has come from various firematic magazines. Regardless of what magazines you read, there are many different answers to the exact same questions. I feel that the real training must be within a local facility where the men can train with the actual fire apparatus and equipment used by their department in their day-to-day operations.

My municipality and our adjoining neighbor, the borough of Dumont, are working presently in conjunction with one another to build a fire training center whereby we would have a facility where we could instruct our member on our own apparatus under actual fire conditions.

It is impossible for me as chief of a department to send several pieces of my fire apparatus to a county facility which is an hour away. Not only would I be losing valuable fire protection from the borough, but I would also be asking my volunteers to spend additional hours away from home and family. If the Federal Government could allocate funds for the purpose of contructing local training sites it would greatly ease the burden on the municipalities themselves and would enable us to maintain a more efficient operation.

There are many grants available for an educational study on the feasibility of establishing such sites, but yet, we can't extinguish the fires with the studies. We need places where we can get the practical experience.

Firefighting has to be a rapid and orderly operations without endangering personnel. It has to be a coordinated team effort. Firefighting is not a game of chance, but one of efficiency and technology.

I'm sure if you checked the records, you would find out that the volunteers spend more time in schools and seminars than our counterparts. I think there is a serious lack of input from the volunteer fire service who are the largest provider of fire protection in the United States. Simply because a man receives a salary, he is considered a professional I feel I am just as much a professional as he is.

The latest U.S. Fire Administration task force stresses that the emergency medical services be provided from within the fire department. The volunteer fire departments are today overburdened, and to push the handling of ambulance service is going to do nothing but force the volunteers to resign due to the additional hours that must be spent in training in order to meet the Federal and State requirements.

This does not include time spent answering these calls, but whereas a paid fireman could be sent during normal working hours to receive this proper training, a volunteer would have to take time off from his normal occupation without pay or use vacation time to attain this training. If training is at night or on weekends, this interferes with the individual's family life which can, and has, forced dedicated members to wind up with marital problems.

In closing, I would like to make the following recommendations:

Funds should be made available at a local level for such things as establishment of training facilities; purchases of specialized tools and equipment; fire prevention literature for distibution by local departments. Also, the development of standards within the fire service and fund implementation of standardization of fire department hose thread; identification placards for flammability; smoke and fire alarms; furniture standardization; clothing standardization the storage of flammable material; and burn treatment.

This concludes my prepared statement, Mr. Chairman.

Mr. **Brown**. Thank you very much, Chief. We appreciate the contribution which each of you have made. We don't often get a chance to hear from men working directly in the field as you gentlemen are, and it will be very helpful to us.

Mr. Hollenbeck, do you have any questions?

Mr. **Hollenbeck**. Yes, Mr. Chairman. I know we are under some time constraints, so I will ask a few brief questions.

I would like to thank both chiefs—as the chairman mentioned—for giving us a chance to hear firsthand from the men in the field, and also, for introducing, Chief Beyea, some of the human element to this. It's not all a lot of numbers and studies, as you made clear.

I should point out to clarify for the record the area that the chiefs come from, Mr. Chairman. It is one of he most densely populated sections of the country, and the towns and the cities there butt up against one another. You could walk maybe three of four blocks, in some places, and be in another town, so that in the event of a large-scale disaster, be it a fire or a hurricane, explosion, earthquake, several towns can be impacted.

I would like to ask the chiefs, what are you doing presently—what are the localities doing presently—in the area of disaster planning in coordination? Also, if you can, give us any instances of when such a plan or such coordination has been effected.

Mr. **Beyea**. Well, I would like to answer that. There has been—and presently is going on—a feasibility study and they are preparing the disaster plan. My municipality is very unique because we have a rail system running right through our town. What they send up on that rail that's flammable and explosive, it's unbelievable, and we have had instances where hydrocyanic acid—they had a defective wheel on the train car. The railroad thought nothing of taking this hydrocyanic acid and putting it on a siding.

Fortunately, the fire department was up on things and we made sure that it was removed. But there, the railroad was willing to put a very dangerous substance in a populated area.

But as far as disaster planning, there has been a lot of work done on my municipality, plus all the municipalities around us. My town belongs to two mutual aid agreements, and there is study between both associations as to, if something happens, what specialized apparatus would respond, and also as to the dangers to the members of the department themselves plus the residents of the community. It is something that we are working on.

Mr. HOLLENBECK. Has the Federal Emergency Management Agency been of any help in preparation of these studies?

Mr. BEYEA. Well, like I stated before, I myself don't fully understand the Federal Emergency Management Act. I know it was established. I personally have had no dealings with it, but now, through all the literature I have received, if I could find out more information—we would be dealing with the Fire Academy, and they could possibly help us very much.

Mr. VICCARO. As far as disaster planning goes, I am ashamed to say it's almost unheard of in North Bergen. We've tried, back in 1974, to have a coordinated disaster—mock disaster—which involved the civil defense and State police and ambulances.

Unless you gentlemen have ever been in the area, it's very difficult. I have a long township, which is shaped something like Florida. Any pieces of equipment I pull out of the area leaves an area completely unprotected. So for me—or any one of our small communities—to bring several pieces of equipment together in preparation for a disaster drill is virtually impossible.

The frequency of alarms, the motor vehicles accidents, the traffic conditions—we're just not set up for it. We can't handle it. And as I said in my statement, we have all we can do to provide adequate extinguishment.

The solution to our problems lies in, for instance, the federally funded study done by Stevens Institute, which recommended consolidation of the small departments. We have long been a focal point in many publications for many years as a total waste area. You can go down Kennedy Boulevard, and one side is South Bergen and the other side is Union City or West New York or Gutenberg. We have engines right across the street from one another that will not respond from one side to the other.

We operate a mutual aid program and we do assist each other as much as possible, but every time we do, we put a strain on our own community. In that area, North Bergen is one of the only towns that can handle two simultaneous fires.

But as far as preparing for disasters, I am sure FEMA in the long run is going to be quite helpful to us, but the small departments need help now. As far as us being able to prepare for these things, no. It's just not feasible.

Mr. HOLLENBECK. Thank you.

Mr. Chairman, I will hand it back to you.

Mr. **Brown**. Gentlemen, thank you very much for your testimony. It's been very helpful to us. I can see that the Fire Administration has got a big job cut out for it in helping departments like yours all around the country.

Thank you very much.

Mr. **Hollenbeck**. Mr. Chairman.

Mr. **Brown**. Yes.

Mr. **Hollenbeck**. I would like the opportunity to submit several more questions in writing to the chiefs.

Mr. **Brown**. Fine.

Mr. **Hollenbeck**. They could answer them for the record to amplify on some of the statements that they've made.

Thank you very much.

Mr. **Brown**. I am going to be calling on Mr. Vickery for rebuttal to Mr. Herchert if he wishes to offer it at this time.

We welcome you back and appreciate your being here.

Mr. **Vickery**. Thank you, Mr. Chairman.

It's really not a rebuttal, it's a reaffirmation of the comments that Mr. Herchert made. That may surprise some, but I think that he was right on the problems that he identified about the fire service and how we function. I would have to almost identify with and support each of the complaints and criticisms that he made.

The reason I am up here is to agree with what he said were existing problems, however, I disagree with some of the solutions that he used in Kansas City. I think that's what the Fire Administration is all about; to lend professionalism, advice and guidance to areas that want to make significant changes. Many of the things that were done in Kansas City in attempting to resolve the problems he stated were things that were not in conformity with what are considered good existing practices nationwide.

I support his testimony and his reference to the lack of progress in the fire service, but I disagree with some of the solutions that he provided. The Fire Administration is attempting to put together a package to aid other people who feel as he does, and to make chiefs feel that this is the direction that the fire service should be pointing.

Mr. **Brown**. We appreciate that comment, Mr. Vickery. The committee, of course, is looking forward to an aggressive program in the Fire Administration to bring about the kind of professionalization which Mr. Herchert referred to and to assist in identifying and removing the institutional barriers that I think do exist toward achieving this professionalization.

Mr. **Vickery**. Thank you.

Mr. **Brown**. All right. Thank you very much.

Our colleague, Mr. Anthony, is here and we would like to have him present his statement and make any contributions he would like at this point.

Mr. Anthony?

Mr. **Anthony**. Thank you, Mr. Chairman. I do have a prepared statement that I would ask unanimous consent to have placed in the record.

Mr. **Brown**. Without objection, it will be in the record.

## STATEMENT OF HON. BERYL ANTHONY, JR., FOURTH DISTRICT, ARKANSAS, U.S. HOUSE OF REPRESENTATIVES

Mr. ANTHONY. With your permission, I would just like to summarize and paraphrase some things that I am particularly interested in. I preempted this testimony somewhat by attending the subcommittee hearing 2 days ago and jumped the gun with your permission.

I would like to have the record be very clear that I am a strong advocate for the master planning section of the Federal Emergency Management Agency, and also a very strong advocate for the Agency itself and any support that Congress can give it to see to it that it can grow and mature and help States, and especially districts like mine that I have found to be so keenly inadequate in fire protection, as was graphically shown 2 days ago and as will be illustrated by a map that is contained as a supplement to my testimony.

It will show the fire death rate per million in the State of Arkansas, and I represent 24 counties in the southern portion of Arkansas, and you can see that I represent too many counties that have the highest classification of fire deaths.

I have recently been able to secure the assistance of the master planning section, and they have made a commitment to come into my district and to do a comprehensive analysis and study so that we can highlight to the local officials and to the State officials the need for a comprehensive plan so that we can do things on a cost-sharing and effective basis. I am looking forward to the end product so that we can begin moving in that area.

Over and above just fire itself, I think my district, again, is a unique district in that it can show the need for comprehensive planning over and above just one element of danger to the public, and that being fire.

A recent map that has been distributed shows that Arkansas is within earthquake areas and, in fact, shows that Arkansas has received minor earthquake shocks, but very small when compared to your State of California.

My district happens to be right in the heart of a tornado zone, and we are not very far from the tornado season, and there is no doubt in my mind that I will be able to report back to you within the next 90 days that a tornado has touched down and has played havoc in my district. Last year we were fortunate in that we suffered millions of dollars in property damage, but we didn't have any deaths due to the tornadoes. I hope we are as fortunate this year.

My home area and the counties immediately surrounding my home county have many chemical companies, because we are an oil-producing area and we have refineries and we have bromine plants, and there are many hazardous chemicals that are transported in and out because of that industrial complex. In fact, during the course of my campaign, we did have a very serious railroad derailment and one of the smaller towns had to be partially evacuated for the safety and the health of the inhabitants.

It brought to my attention during that period of time that there was really no adequate evacuation plan and no hazardous safety plan totally in place, and I thought that was a terrible lacking for an intelligent and modern-day society.

I also have an arsenal in my district where munitions are stored, so when you combine them all together, you can see that my district represents a microcosm of how important it is for the Federal Emergency Management Agency to be alive and well and to be able to do master planning so that the citizens can have the benefit of their expertise.

I would just like to make one further comment. I am sorry that I did not hear all of the testimony of Mr. Herchert, but I would like to say that he is the former city manager of one of the larger towns in my district, and he and I have many mutual friends, and we had a close relationship when I was a prosecuting attorney there. So I know of his background and his desire to accomplish the good for the people also.

With that, I yield.

[The complete prepared statement of Representative Beryl Anthony, Jr., is as follows:]

STATEMENT OF
REP. BERYL ANTHONY, JR.
FOURTH DISTRICT - ARKANSAS
BEFORE THE
SUBCOMMITTEE ON SCIENCE, RESEARCH, AND TECHNOLOGY
OF THE HOUSE SCIENCE AND TECHNOLOGY COMMITTEE
FEBRUARY 28, 1980

Mr. Chairman, I am pleased to appear before you and the other members of the subcommittee to speak on the Master Planning Program of the U.S. Fire Administration and the coordination of fire prevention and control with other types of hazard mitigation under the purview of the Federal Emergency Management Agency.

The State of Arkansas has one of the highest fire death rates in the nation and the industrialized world, with an average of over 42 deaths per million people each year. Twenty-one Arkansas counties, including six in the Fourth Congressional District, have an average fire death rate of over 50. Nine counties, including three in my congressional district, have an average fire death rate of over 35.

Arkansas' fire death rate is accentuated because, compared to other parts of the country, larger percentages of our population live in rural areas and fall below the poverty line. But, fire protection in many of our cities, communities, and rural areas is inadequate. And, if concepts don't change, it is likely to remain inadequate, especially in the face of rising costs and increased competition for what funds are available.

Even if resources in communities are relatively scarce, though, there are some ways in which fire protection can be improved and the death rate lowered. Wonders can be accomplished at small cost by a well-organized, diversified volunteer effort, an effort that involves all parts of local government and the citizens of the area. I am speaking of master planning.

As you know, fire protection master planning is a systematic process for determining how much fire risk a community is willing to assume, how much fire protection it can provide, and alternative approaches for providing that protection. The development of a total community plan by that community, it looks at today's fire situation, anticipates tomorrow's problems, and designs alternative plans and costs and benefits to meet fire protection needs.

I understand that there are about 1,200 communities currently engaged in fire protection master planning. Most of these towns and cities range in population from 10,000 to 100,000 and have a high percentage of fire service personnel employed on a full-time basis.

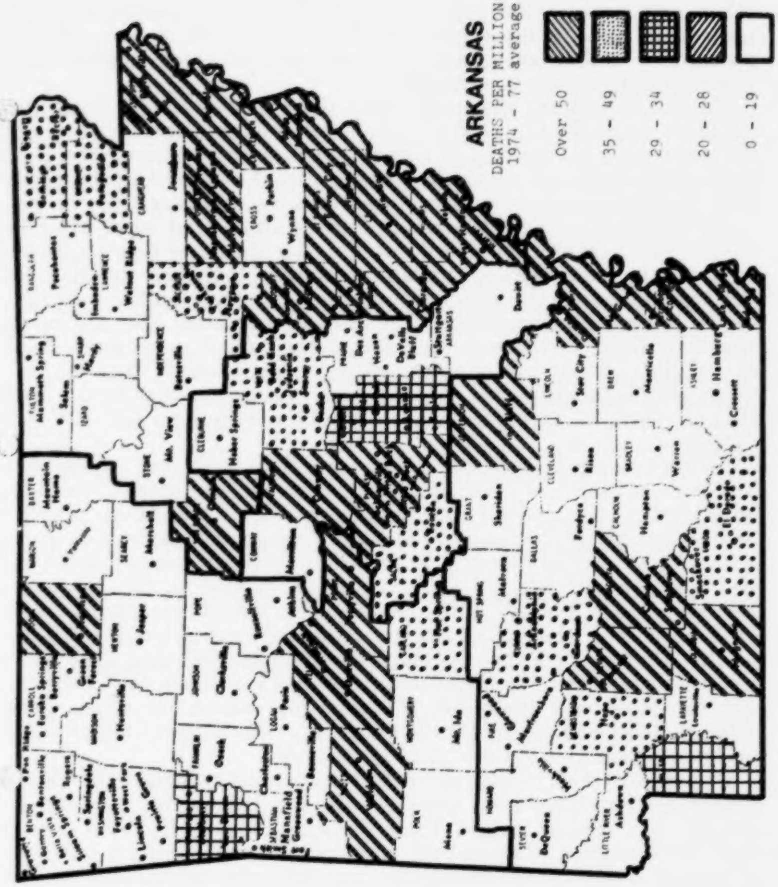
The largest city in my district has a population of 57,300. The next largest cities have populations of 25,200, 21,600, and 16,000. There are only three other communities with populations near 10,000. From that point the population levels drop significantly. There are county seats in my district with populations under 2,000. Obviously, these communities must make the best use of what money, personnel, equipment, and facilities they have available to them.

At my request, the U.S. Fire Administration will be supplying the technical assistance the people of South Arkansas need for comprehensive fire prevention and control planning. With their assistance and the cooperation of members of municipal and rural fire departments, local government officials, and the citizens of the Fourth Congressional District, we will plan and implement a program of action. With master planning, we can manage the cost of fire protection while increasing life and property safety.

A report to the Congress states that master planning is a remarkably effective management tool for helping local communities. Efforts have resulted in improvements of new protection programs aimed at reducing fire losses and increasing the efficiency of delivering fire protection to the community.

I believe that if master planning has proven to be this successful, it should be coordinated with other types of hazard mitigation under the purview of the Federal Emergency Management Agency. Other FEMA offices are already involved in programs to increase the capabilities of the United States to predict, prevent, and respond to emergencies and disasters, and to recover from their impact, These activities should also be directed towards assisting local communities with plans for reducing life loss, injury, danger, and economic and social disruption from a broad spectrum of disasters, emergencies, and hazards.

The commitment to the development and support of the fire prevention and control master planning program made by the U.S. Fire Administration should be broadened to a commitment to the development and support of a coordinated program of fire prevention and control and disaster mitigation made by the Federal Emergency Management Agency.


ARKANSAS
DEATHS PER MILLION:
1974 - 77 average
Over 50
35 - 49
29 - 34
20 - 28
0 - 19

Mr. **Brown**. Thank you very much, Mr. Anthony.

I think your testimony supports the emphasis that we've had from other witnesses on the importance of the master planning for fire protection, and, to the degree possible, integration of that with the planning of other emergency services and, to some degree, other Government services in general.

I'd like to just ask if you feel that there is a particular focus that could be made on the needs of the rural communities, because they do represent a major area of risk throughout the country. And if we are neglecting that, I think the Congress would want to see if in some way the program could be structured to correct that neglect.

Mr. **Anthony**. Well, I would say three areas need to be attended to, and as much effort is placed into fire education and prevention and as much dissemination of available materials that does go on, I will say that, based on the one-half-a-day seminar that I held, that there was still almost a complete lack of knowledge among the people who were interested in the various communities where they could obtain the material, what material was obtainable. It seems that our outreach efforts for education are truly not getting down into the areas that it needs to be gotten into. I would continue strong efforts in that area.

As my comments indicated 2 days ago, their problems are the same problems as everybody else has, it's money and equipment. I feel very strongly that this committee should throw its full weight and support behind having the Federal Emergency Management Agency have the authority to get the property so that that property can be loaned out, and more importantly, if the title can be passed to that property, because, as Mr. Vickery indicated the other day, those people on the local basis with their expertise and auto mechanics, body work and all this, they re-work that equipment to such an extent that you would never realize it from its original state, and it's a shame that they cannot continue with the pride of ownership, especially when you're talking about equipment that has basically been depreciated off and is no longer useful for the Federal Government.

I would say that, in looking at the total budget and all of the various programs that have been allocated for fire prevention, and the net results that can be gained from the expenditures of those dollars, that the Congress has not been responsible in allocating a fair share of money so that it can trickle down to the local communities so that they can do a better job.

As I indicated the other day, Mr. Chairman, when grown men have to dress up like women and go public on stage in a small high school in a town of 700 to raise enough dollars so that they can construct a building to protect their equipment, then I would say that that's grassroots support, and that the Congress ought to throw its might behind it. We have so many wasteful dollars going around, we ought to find some area that we can conserve some of those dollars and get it down to the people that will truly utilize it.

I will say this. If we can get some of those moneys down to the local grassroots support people in rural fire protection, the image of the Congress would go up. The public would finally realize that we're doing something to help them, and I'll say this, the public's image of the Congress, I think would go up dramatically.

So just to summarize, better education, take the shackles off the means to get the equipment to the local communities, and then let's fight hard to reallocate some dollars into their treasuries.

Mr. Brown. All right. We'll do our very best to accomplish those goals. And thank you very much for your statement.

I would like next to call Prof. William Hall, department of civil engineering, University of Illinois. We are going to spend the remaining period this morning on a discussion of the problems in earthquake engineering, which, of course, is another part of the responsibilities of FEMA, and get the views of several experts from outside the Government on what needs to be done in this program area.

Dr. Hall, we would like to call the other two witnesses up also, Mr. Moore and Mr. Elsesser.

We would like to have—if you can—each of you present your statements this morning, and then if you could agree and we haven't had a chance to ask questions, those of you who can return, we will try to question this afternoon.

We are interested in the adequacy of the earthquake engineering/earthquake research programs and the reactions that you gentlemen might have as experts in this field to the scope and type of program we have and what might need to be done to modify the program.

If you would proceed, Dr. Hall, we would appreciate it.

Dr. Hall. Thank you, Mr. Chairman.

I appreciate being given the opportunity of testifying here today. I have supplied written testimony which I trust you have in hand——

Mr. Brown. Yes.

Dr. Hall. I would like to paraphrase that slightly, and supplement it, particularly at the end, with regard to some recommendations.

Mr. Brown. The full text will appear in the record.

[The biographical sketch of Dr. Hall follows:]

# BIOGRAPHICAL SKETCH
## WILLIAM J. HALL

William J. Hall, Professor of Civil Engineering at the University of Illinois at Urbana-Champaign, has been a member of the faculty at the University since 1954. Currently he is director of a major research program at the University sponsored by the National Science Foundation in the area of earthquake engineering and focused on developing improved approaches to structural design.

He was born in Berkeley, California, attended the University of California at Berkeley in 1943-1944, and after the war attended the University of Kansas, Lawrence, Kansas where he received a B.S. degree in Civil Engineering in 1948. During 1948-1949 he worked for the Sohio Pipeline Company, a subsidiary of the Standard Oil Company of Ohio. He entered the University of Illinois to undertake graduate study in September 1949 and received the degrees of Master of Science in 1951 and the Doctor of Philosophy in Engineering in 1954.

He has received numerous awards including election to membership in the National Academy of Engineering in 1968.

He is author or co-author of over 110 books and articles in the fields of structural engineering, structural mechanics and dynamics, earthquake engineering, plasticity, fatigue, brittle fracture mechanics, civil defense and education.

He serves as a consultant to a number of industrial organizations and governmental agencies; this work has included participation in studies of military protective structures, development of seismic design criteria for nuclear power reactors and related facilities, and in the design of the trans-Alaska pipeline. He is currently chairman of a committee of the National Research Council (Office of Earth Sciences) to develop long-range research recommendations devoted to improvement of the siting of critical facilities. He is a director of the Earthquake Engineering Research Institute and was a member of the U.S. Delegation on Earthquake Engineering and Hazard Mitigation to the People's Republic of China in 1978.

## STATEMENT BY DR. WILLIAM J. HALL, PROFESSOR OF CIVIL ENGINEERING, UNIVERSITY OF ILLINOIS, URBANA-CHAMPAIGN, ILL.

Dr. HALL. As a result of perhaps at least a quarter of a century of basic and applied research—I will allude to the sources of support a little bit later—and particularly in recent years, research carried out at universities, engineering foundations, governmental laboratories, and nonprofit institutions, there is no question that major advances in earthquake-resistant design have been made.

These advances are reflected in improved building codes, and in rational design criteria for our critical facilities, such as nuclear powerplants, pipelines and offshore structures.

In those areas where the newer building codes are enforced and applied with good judgment and proper knowledge, there is no question in my mind that we are in a much better condition than we were 20 years ago with regard to collapse of buildings, and with regard to protection of human life. There is still a great deal to be done, of course.

We still suffer tremendous amounts of damage in earthquakes, even in buildings which are not grossly damaged, both to exterior architectural features, and to interior features, such as mechanical and electrical equipment. There is a tremendous amount of work in this area that we can and should do.

In my testimony I have given a statement about hazards. In our country, as we have an increase in population and urban sprawl, it is obvious that our potential for damage is increasing. Perhaps the most obvious indication of this exposure is reflected in the devastation caused by the earthquake in Tangshan, China, in 1976. I am sure you are aware of this earthquake. There is a report that has just been released. I don't know whether you and the committee have had a chance to look at this report. I will leave this copy with you.

This is a report by a group of us that went to China in 1978 to look specifically into the Tansghan earthquake at, least much as the People's Republic of China representatives would tell us. I think this is the most information by far that has been brought out of China. I think you would find this quite interesting in terms of what happened.

Mr. BROWN. Without objection, that will be made a part of the committee's record. Thank you very much.

[Copies of the report, "Earthquake Engineering and Hazards Reduction in China" 1980, are available from Office of Publications, National Academy of Sciences, 2101 Constitution Ave. NW., Washingtion, D.C. 20418.]

Dr. HALL. It is reported there—as you probably heard—that perhaps upwards of 650,000 people were killed, probably more than that were injured, and the industrial and property damage was staggering.

Also, when one looks at the hazard in the sense of the earthquakes up and down the coast of the Western Hemisphere, it is really interesting. I have never put it in that context before, but it is in the records. Starting with Alaska in 1964, it seems like every 2 or 3 years we have had a major earthquake which has had associated with it a large loss of life and property. So, we of course, can see this is a real problem and I won't elaborate on that.

As far as research accomplishments, you have had filed with you by the National Science Foundation, the U.S. Geological Survey, and other agencies, documents which give very detailed information about the accomplishments of the program.

I thought it might be most interesting perhaps, to have one talk about some of the research advances with which one has been involved and I have listed some of these in my testimony. One of them is the Applied Technology Council study on "Tentative Provisions for the Development of Seismic Regulations." I am sure you have heard a lot about this project. This particular report is an excellent example of what can be done in terms of translating research into practice. It incorporates much of the latest technique in terms of input from the Earth sciences field, from the structural field, and so forth.

There are some shortcomings in the report; these are being worked on, but I personally would predict without any trepidation that over the next 20 years the philosophy, principles, and the procedures that are incorporated in this document are going to be the basis of the building codes of the future. So this is perhaps a superb illustration of the translation of research to practice.

Other aspects like this have to do with nuclear powerplant design. I have been involved in this field for a number of years. Perhaps this is the area in which the pressure has been the greatest to translate research into practice, by virtue of the critical nature of the facilities.

I mentioned in there the new gas centrifuge uranium hexafluoride enrichment plant in Portsmouth, Ohio, which is in the Central United States, which has been designed to incorporate earthquake resistance; the trans-Alaskan pipeline, on which many of us worked, heavily incorporated the latest information up to the time it was designed in the early 1970's. I can assure you from personal involvement that the gas pipeline down through Alaska and Canada is going to have the same type of late technology applied, so you can see some of the research transfer that is going forward.

Also, currently there are research studies on bridges. We have had no major studies on bridge design to resist earthquakes until recently. This is a major step forward by the Applied Technology Council.

I also mentioned in my testimony that it was just about a month ago that I was contacted by a defense contractor about the use of our work at the University of Illinois on protection of ballistic missile systems specifically with regard to the protection of the guidance systems, from earthquakes. This is an interesting cross-discipline application.

Not the least of our research products, as a university professor would point out, are the students whom we train who are the backbone of our future technical cadre.

With regard to the research areas, I will mention briefly the major items. There is still a lot to be done. We have made many advances. I discussed in my testimony the items that I think really need further attention, and I think that you will see that the other members of the panel sitting here will support these almost one-for-one also, which is not surprising.

There is a lot more research work to be accomplished.

It takes time to get this research done. An often overlooked matter is the fact that during and after World War II, many of us did a tremendous amount of research work in fields related to military protective structures and blast protection.

This background of work in structural testing, analysis, and shock-loading of equipment, has provided a tremendous base of information on which to build in the earthquake engineering field. This cross-fertilization between areas is extremely important, and in fact, as I just mentioned some of our work in earthquake engineering now has application in the military field.

We have other areas. We have wind, tornadoes, floods, explosions, and so on. It has not been feasible to conduct research work in all of these areas, a fact which those of us in the research field appreciate; we make the utmost use of existing information in the development of the criteria for these various engineering applications.

It is clear that we must have an ongoing strong program in the Earth sciences. This is one of the bases of the earthquake engineering field in terms of ground shaking, faulting, and related phenomena. You will hear more on this from others on the panel.

We do need more work in experimental research. This is very expensive and time consuming, but we have been deficient in recent years in carrying out studies on components, models of buildings and connections, and we do need a few full-scale tests.

In the analysis field, this is a continuous area of endeavor which must go forward. There is a need for additional work on low- and medium-rise buildings, in contrast to high-rise buildings. After all, most of our cities consist primarily of low- and medium-rise buildings and the damage in earthquakes is primarily to these types of structures. We must pay more attention to these buildings.

In the same way, we need to be more concerned about hazardous existing buildings. How do we evaluate how hazardous they may be? Can we retrofit or strengthen these buildings? In many cases, this is very expensive; in some cases impossible. Then what do you do if you cannot upgrade the building; this is a thing that hopefully FEMA and other groups can get into in more detail.

There are others. I personally think that the architectural features—for example, cladding—and internal building items—for example mechanical/electrical—need major study in terms of their resistance to earthquakes and ability to function. Similar comments can be made in the matter of lifelines—pipelines, water lines, sewer lines, transmission lines—and these are important items about which we have insufficient knowledge and for which more research is required.

So there is a tremendous amount of work to be done. And it is going to take cooperation among all of the agencies involved, including USGS, National Science Foundation, and FEMA, of course, which is really the lead agency, the National Bureau of Standards and so forth.

I would like to conclude by referring to a statement I made in my prepared testimony, at the bottom of page 2.

"It is my belief that the earthquake engineering research program, which rests primarily in NSF"—and incidentally, since we have a program that has momentum and a sense of mission identity, I think it should stay there—"should be continued for the next 4 to 5 years at annual levels of funding equal to those commensurate with plan B of the Newmark-Stever report, with adequate recognition for inflationary adjustment."

I'll come back and say a few words about this.

"At the end of that period, the entire earthquake research program should be reexamined for its effectiveness and its real and potential accomplishments," but that's not to say that we're going to be finished, because in an area like this you just don't do some work and then just stop. Obviously, there has to be some mechanism to continue this type of basic engineering research.

With regard to my statement about funding, if I read things right and we look at the Newmark-Stever report, over the 3-year period that it called for—in that particular area that I'm directing my comments to—it called for about $80 million, so if you divide that by 3, you get something like $26 million or $27 million a year.

It has not been funded at that level fully. It seems to me that the program could go forward at that level. The agencies involved, particularly NSF, could handle that level of funding. This is not a big increase. We are not asking for a big increase—it is not called for—but I think it is necessary to go forward with a strong, well-funded, sound program.

Thank you, Mr. Chairman.

[The complete prepared statement of Prof. William Hall is as follows:]

# Testimony of
# William J. Hall
# to
# The Subcommittee on Science, Research and Technology of the Committee on Science and Technology, U. S. House of Representatives

February 28, 1980

My name is William J. Hall. I hold the position of Professor of Civil Engineering at the University of Illinois at Urbana-Champaign, Urbana, Illinois.

I appreciate being given the opportunity of testifying before this committee on the subject of earthquake engineering research, and specifically as it pertains to structural engineering and related topics. At the outset I should like to observe that as a result of research conducted over the past quarter century in universities, engineering firms, governmental laboratories and non-profit institutions, major advances in earthquake resistant design have occurred. These advances are reflected especially in improved building codes, and in rational seismic design criteria for critical facilities, such as nuclear power plants, pipelines and offshore structures. There is no question that research in past and recent years, coupled with observations and studies of actual earthquake effects and damage, has served to provide a much more satisfactory basis for, and a higher confidence in, the current building codes. More simply, structures designed to current codes are safer generally in terms of protection of life by virtue of limiting the potential for collapse.

However, even in buildings which have not suffered collapse in an earthquake, there can be great damage to the building and its contents. In the region of an earthquake there can be great damage to other facilities. To design and build in such a manner that no damage would occur is clearly prohibitive from a cost standpoint on a national scale; the goal is to construct buildings and facilities in such a way as to minimize societal risk (in terms of life, especially, and property damage) in the light of realistic cost. It is clear to those of us in the engineering community that we should, and can, do much more to minimize property damage and economic loss, and at the same time minimize further the associated threat to life.

The current research programs in earthquake engineering and earth sciences are leading to fundamental understanding of factors that will be reflected in increasingly more rational codes, criteria, and design techniques in the years ahead; moreover, they will serve as a strong support base for the overall earthquake hazards reduction activity that is urgently needed. With annual construction investment estimated to be in excess of $100 billion per year, and one-third of this amount located in high and moderate seismic risk regions of the country, it is clear that this type of investment, much less the inhabitants, needs protection.

It is my belief that the earthquake engineering research program, which rests primarily in NSF and now possesses momentum and a sense of mission identity, should be continued for the next 4 to 5 years at annual levels of funding equal to those commensurate with Plan B of the Newmark-Stever report (Ref. 1), with adequate recognition for inflationary adjustment. At the end of that period, the entire earthquake research program should be reexamined for its effectiveness and its real and potential accomplishments.

In order to elaborate on the above statements and in order to underscore the importance of the earthquake engineering program, I wish to concentrate my remaining observations under three sections as follows:

The Earthquake Hazard
Research Accomplishments and Applications
Research and Research Goals

## The Earthquake Hazard

The potential for loss of life or injury and for property damage in an earthquake is dramatized by the recent July 1976 Tangshan earthquake in the Peoples Republic of China. In that earthquake about 650,000 people were reported to have been killed, perhaps even more were injured, and extensive property damage occurred. The best account of the destructive nature of that earthquake is contained in the trip report of a 1978 technical delegation to the Peoples Republic of China (Ref. 2). Relatively recent major earthquakes in the western hemisphere include Alaska (1964), Venezuela (1967), United States (San Fernando, CA) (1971), Nicaragua (1972), Peru (1974) and Guatemala (1976), all of which were accompanied by loss of life and significant property damage; one of the largest series of earthquakes in our country occurred in the central United States (New Madrid, MO) in 1811-12.

In our country the potential for loss of life and property damage increases yearly as our population grows along with its accompanying urban sprawl of housing and industry. Realization of the increasing risk, and steady research accomplishments, have led to improvements in building code provisions to resist earthquake effects in some areas of the country. Where such improved codes are in effect, there most assuredly will be an attendant decrease in loss of life if an earthquake occurs, but the potential still exists for significant property damage and economic loss.

## Research Accomplishments

A description of the accomplishments of the national earthquake engineering research program has been prepared recently by NSF (Ref. 3). The accomplishments over the years by various groups include fielding of strong ground motion instruments, acquisition and processing of ground motion data, development of techniques for predicting ground motion emanating from fault regions, development of structural and soil-structure interaction dynamic analysis techniques, development of response spectrum analysis procedures, major contributions to upgraded seismic building codes, improved seismic design procedures for bridges, and a greatly expanded base of knowledge for use in developing seismic design criteria for critical facilities. Although the accomplishments are truly impressive, they go only part way in providing the technical engineering base for a comprehensive earthquake hazards reduction program for the United States.

In that which follows I wish to describe several examples of research applications in which I have had personal involvement, including some that are of a kind often overlooked in documenting formal accomplishments.

One major accomplishment noted in Reference 3 pertains to the Applied Technology Council study entitled "Tentative Provisions For the Development of Seismic Regulations for Buildings," normally referred to as Report ATC-3, and funded by NSF through NBS. This document, containing recommended procedures and commentary on building design, is in some respects an interpretative report; it synthesizes much of the recent research applicable to buildings, that is, research for which reasonable confidence exists that the findings are ready for application in practice.

The goal was to develop rational procedures employing the latest technology that would allow the engineer or architect to identify the variables employed during the design process instead of having them implicitly included (hidden) in the empirical code procedures. The contributions of the ATC-3 effort to seismic building design include such new items as (a) comprehensive hazard analysis, (b) application of response spectrum structural analysis techniques in an explicit manner, (c) introduction of soil-structure interaction, (d) introduction of modal analysis, (e) use of a limit stress approach for all construction materials considered instead of a mixture of working stress and limit stress approaches as in current codes, and (f) explicit recognition and use of nonlinear (ductility) concepts.

It was obvious to anyone working on this comprehensive project that some topics need additional study; in spite of these partial shortcomings I predict that every major building code developed in the next 20 years will be based in part on the philosophy, principles and procedures put forth in this document. The project represents a major step forward in the improvement of building code practice and constitutes a superb illustration of the translation of research accomplishments into practice.

Seismic design criteria and procedures employed for nuclear power plants have evolved rapidly over the past 15 years. The procedures employed in the seismic design and seismic design review process of such facilities are based on investigations undertaken as a part of the earthquake engineering research programs by universities, governmental agencies, industry and other groups. Similarly, the new uranium hexafluoride gas centrifuge enrichment plant in Portsmouth, Ohio has been designed to incorporate earthquake resistance.

The trans-Alaska Pipeline System, which traverses a highly seismic region in Alaska, was designed in the early 1970's. The seismic design of the pipeline, facilities, and equipment, a principal concern for protection of the environment and the pipeline, is based on criteria and concepts that arose out of the ongoing earthquake engineering research program.

A developmental research program on bridge design to resist seismic effects, the first major study of its kind, is currently underway by ATC under sponsorship of the Federal Highway Administration.

About a month ago I was contacted by a major defense contractor desiring information from our ongoing NSF sponsored earthquake engineering research program at the University of Illinois for application in ballistic missile system design studies.

Not the least of the benefits to be derived from such research, over and above the research findings themselves, is the training afforded young engineers while working on research projects in the universities. These young men and women are the backbone of our future technical engineering staffs in industry, government and the universities.

These research accomplishments and their application in practice are but a small number of those that the group testifying before your committee can, and perhaps will, cite. It is obvious that the research results have far-reaching applications of great importance to the welfare of our nation.

## Research and Research Goals

The research base on which our current practice rests has involved contributions not only from the earthquake engineering research program but also from research undertaken in many other subdisciplines. For example, although often overlooked, beginning in World War II and continuing into the late 1950's there was an extensive military research program directed to the design and construction of protective structures, with great emphasis on the static and dynamic testing of structural components. This reservoir of data has proven extremely useful, even today, in evaluating the resistance of structural elements to seismic loading. Also during this same period there was great activity in the formulation of analysis techniques for estimating the effects of dynamic loading on structures, and much of this effort has played a role in the developing earthquake engineering field. In the same manner some of the concepts and techniques developed for shock loading evaluation of military equipment, as well as the actual test results in a number of cases, have found application in the seismic design of equipment. Assuredly, many other examples of research applications from allied areas could be cited.

Just as early research in protective structures benefited earthquake research, some aspects of our earthquake engineering research have benefited the design of military systems. In the general area of structural dynamics, which deals with effects arising from all types of natural and man-made hazards (earthquakes, wind, floods, explosions), it is fortunate that such supportive interrelationships exist for it has not been feasible to undertake the desired research in all these areas.

It is clear that the research accomplishments of the past (Ref. 4), and especially those of recent years, along with observations and interpretation of earthquake damage, have led to a much sounder basis of design and construction to resist earthquakes. The recent governmental agency reports to your committee, of which Reference 3 by NSF is typical, provide detailed summaries of needed research. In this concluding section, I should like to comment briefly on those items which I believe need special research attention in the years immediately ahead if we are to upgrade significantly our ability to provide protection against earthquakes.

It is interesting to note that the first recorded strong ground motion was in the Long Beach, CA earthquake in 1933, less than 50 years ago; at about the same time the building codes began to call for rudimentary earthquake resistant design. The advances in the earth sciences, as related to understanding of strong ground motions (for example, ground shaking and faulting), provide the basis for new and improved developments of earthquake resistant design criteria. The new information related to the October 1979 Imperial Valley Earthquake is of this type. Obviously there is a need to maintain close cooperative effort between the earth sciences and engineering disciplines to insure that the strong ground motion data, as well as related observations on basic earthquake characterization, are available for engineering investigation and application as expeditiously as possible. There are a number of other topics closely related to earth sciences, in the geotechnical area, that will be addressed by others in these hearings, as for example the important considerations related to dam safety, slope stability, and liquefaction, items typical of those that must receive consideration in the design of almost any major facility.

Experimental test data, the bases for understanding most structural behavior, have been accumulated slowly over the years from research programs in many structural laboratories, primarily in connection with studies of building and bridge components. In the last several decades such studies have been few in number and limited in scope, in large part because of their high cost. Our background of basic data, as valuable as it may be, is limited and incomplete especially when we wish to investigate behavior in the nonlinear range, and attempt to assess the margins of safety of structures which have been severely loaded by an earthquake. There is a need to accelerate the testing of components (including connection elements), and small-scale and in some cases full-scale structures for all of our common construction materials, including reinforced concrete, steel, masonry and wood. The best test, unfortunately, is an actual earthquake; in this regard it is important to go forward with comprehensive programs of evaluation of selected existing buildings following an earthquake (both damaged and undamaged buildings), especially if they are instrumented. Such studies of full-scale structures are expensive and time consuming, yet extremely valuable.

It is often difficult to separate the analysis and design aspects in research and practice since they are so closely interrelated. Obviously we must continue to improve our analysis tools that are so much a part of the design process, and especially as we concentrate in the next decade on development of techniques for designing and constructing structures to take advantage of nonlinear behavior and soil-structure interaction effects. Much more research attention must be devoted to the design and response of light-frame and low- to medium-rise buildings, which constitute the majority of our buildings and which invariably suffer the most damage in earthquakes throughout the world. And, in connection with hazard reduction activity, it is clear that we shall have to give much more attention to existing hazardous buildings, especially to the development of methods to assess their resistance to earthquake effects and of approaches for strengthening when appropriate or possible.

Two other important areas of research that must be pursued vigorously in the near future, especially if injury and damage are to be reduced, include (a) architectural building features (exterior appendages and building cladding, and interior furnishing and fixtures) and (b) mechanical and electrical equipment in buildings and industrial facilities. The dislodgement of the former, and damage or loss of function of the latter can lead to serious difficultues in an earthquake.

Other important areas include consideration of lifelines (for example, gas and liquid fuel pipelines, water and sewage lines, electrical transmission lines and their supporting facilities). In a similar vein one could list such generic topics as the need for effective techniques for estimating structural and mechanical reliability as a part of risk assessment investigation.

In summary, in the light of the increasing potential for exposure of people and facilities to earthquake effects, and in order to reduce the danger to people and to reduce the level of economic loss arising from property damage, it is highly desirable for the earthquake engineering research program to go forward with a strong base of funding support. The total program of endeavor requires the utmost in cooperation from all the governmental agencies involved (FEMA, NSF, USGS, NBS, etc.) as well as from the private sector if a satisfactory national earthquake hazards reduction posture is to be achieved. There is much that remains to be done.

## References

1. "Earthquake Prediction and Hazard Mitigation -- Options for USGS and NSF Programs," National Science Foundation -- RANN and Department of the Interior -- USGS, Sept. 15, 1976, 76p.

2. "Earthquake Engineering and Hazards Reduction in China", (A Trip Report of the American Earthquake Engineering and Hazards Reduction Delegation), CSCPRC Report No. 8, National Academy of Sciences, 1980, 189p.

3. "A Program for Earthquake Prediction and Hazard Mitigation", prepared by Division of Problem-Focused Research, Engineering and Applied Science, National Science Foundation, 1980

4. "Earthquake Engineering Research", report prepared for the National Science Foundation by the Committee on Earthquake Engineering Research, Division of Engineering, National Research Council/NAE, 1969, 313p.

Mr. BROWN. Thank you very much, Dr. Hall.

Mr. Moore?

Mr. MOORE. Thank you very much, Mr. Chairman.

My name is William Moore and I am here speaking as the Chairman of the board of direction of the Building Seismic Safety Council.

There is a prepared statement——

Mr. BROWN. Without objection, it will be inserted in the record, Mr. Moore.

## STATEMENT OF WILLIAM W. MOORE, CHAIRMAN, BOARD OF DIRECTION, BUILDING SEISMIC SAFETY COUNCIL

Mr. MOORE. Thank you, Mr. Chairman. I think it might be more productive if I don't go through that statement. There are a couple of issues in it that I would like to highlight particularly.

One of these is that, as Dr. Hall has stated, there is a very considerable and important body of technical knowledge currently available which is not being generally used in the business community. The principal thrust of the Building Seismic Safety Council is to try to develop means of getting this information applied in the real world—getting it utilized.

To some extent, I think we really don't know how to do that. You can't just mandate it and wave a wand and have it done. It's an educational process. It would require an understanding of the safety issues that we just listened to.

It is also more than that. I think it involves some studies—I guess you would call it research and development studies—as to how to get this information out and used. What are the impediments? What are the disincentives to its being utilized? What can be done to remove some of those disincentives and perhaps change some of them to incentives? First you have to get an understainding—at any rate, that's the thrust of the Building Seismic Safety Council, toward the implementation and utilization of some of this information, such as that as has been produced by the Applied Technology Council.

I think the Building Seismic Safety Council is one of the first attempts to direct energy toward that implementation as contrasted with the development of the basic knowledge and understanding.

The other thing that's in my statement here, but I'll say it again in different words, is that this is particularly new and peculiar kind of experiment, I think, because the Building Seismic Safety Council involves a combination of the technical people—the engineers, science experimenters—the business sector, the Government sector, the financial and economic aspects—the people interested in the financing of building construction—and the consumer.

In the past, most of the development of criteria for building codes and so on have been handled pretty much in the technical community, among the engineers, and to some extent, the contractors and the building people. This is an attempt now to bring in the people that are impacted by these regulations and let them have a say-so before something is formulated that they then have to live with.

It involves a lot of people who are knowledgeable about the building business and those that are affected by it. The attempt now in the Building Seismic Safety Council is to do this educational process before the regulations are finalized and promulgated, with an objective of creating an atmosphere where they can be generally accepted by the building community and the people affected by it instead of imposed.

I don't know whether this can be done or not for sure. It's an attempt to change the procedures for the development of regulations from one of having them written either by a segment of business or an agency of Government, and then issued, and then hoped people will follow. If they don't believe it, they don't seem to follow, and some of these things have been darn near impossible to get in force or utilized.

At any rate, that, I think, is an illustration of an attempt to a new approach to the development of regulations and creating an atmosphere for their acceptance; that is, we hope to get sufficiently broad consensus among the entire building community and those impacted by it, so that when something comes out—which, hopefully will be good—it will have a chance of a broad acceptance.

If this is successful, and I think it will be, and I think the cost of failure to make it successful is something we don't want to face, it may provide an example for other types of regulatory development and development of other criteria that might be useful in other areas.

I think those are the two principal things that are new about the Building Seismic Safety Council. I have been personally—and the other people involved in this—have been working with FEMA, and I think we are going to proceed with it.

I might make one other comment. There are some dozens or scores of people who are donating their time to this effort, and the funding which the Building Seismic Safety Council may receive from FEMA will be only to cover the expenses and the staff work in order to make use of the work of these scores of volunteer—people who are donating their time—who are knowledgeable in the various technical, business and other areas. The Government and the public are getting probably several times as much value from the donated services as they are from the money to cover expenses.

[The complete prepared statement of Mr. William Moore is as follows:]

# STATEMENT

# OF

# BUILDING SEISMIC SAFETY COUNCIL

BEFORE

SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY

COMMITTEE ON SCIENCE AND TECHNOLOGY

U. S. HOUSE OF REPRESENTATIVES

FEBRUARY 28, 1980

Mr. Chairman and Members of the Subcommittee:

My name is William W. Moore, Chairman of the Board of Direction of the Building Seismic Safety Council.

We appreciate this opportunity to discuss the Building Seismic Safety Council and its relationship to the National Earthquake Hazards Reduction Act.

The 1977 National Earthquake Hazards Reduction Act which, briefly stated, established the Federal objective "to reduce the risk and lives and of property from future earthquakes in the United States through the establishment of an effective earthquake hazards mitigation program," was strongly supported by many of the organizations that currently make up the membership of the newly organized Building Seismic Safety Council.

The national program to implement this Act was proceeded on the basis of a balanced strategy reflecting relative seismic risk and mitigation of highest hazards on a priority basis. Regional differences in the nature and magnitude of earthquake hazards and of the preception of these risks are integral. The Federal government has stated it is committed to setting a strong example in the construction and safety of its own facilities and to developing guidelines and standards for Federally assisted or licensed critical facilities.

Decisions affecting earthquake safety are made by virtually every level of society -- the individual, family, firm, and community. The majority of such decisions are made in the private sector, with some degree of constraint provided by governmental bodies and in some cases direct incentives offered by government. The achievement of a safe environment is basically a shared responsibility of all levels of government and the private sector.

The national program recognizes this principle of shared responsibility and further recognizes that the ability of the Federal government is principally to act in support of, not in contravention of, State and local government, industry and the public.

We believe these form a sound basis for Federal involvement in earthquake safety.

Building codes and standards have been, are, and will continue to be a principal factor to improving the public's earthquake safety, particularly in the continued development, evaluation, and improvement of model seismic design provisions. The far-sighted initiatives and activities of the Applied Technology Council (ATC), the Structural Engineers Association of California (SEAOC), the National Bureau of Standards (NBS), and the National Science Foundation (NSF) and their extensive effort to develop Tentative Provisions For Seismic Regulations For Buildings, is a matter of record. These provisions embody a number of new concepts and consider classes of problems which are significant departures from existing design provisions. The Applied Technology Council and the National Bureau of Standards, in cooperation with the organizations mentioned, and the Building Seismic Safety Council have now developed design evaluation procedures to be used to test the life safety performance and economic implications of the tentative provisions.

But even as broadly based as the participation in ATC activities was, there are still many institutions and interests that were not part of the development process. An historically major impediment to achieving improved earthquake safety has been that the diverse elements of the building community (professional societies, and labor, trade, model code, voluntary standards, public interest and public agency organizations) have not had a forum to develop such standards. We hope that this has been remedied through the formation, in April 1979, of the Building Seismic Safety Council (BSSC) as an independent, voluntary body to enhance the public's safety by fostering improved seismic safety provisions. The Council was formed through the efforts of organizations representing all segments of the building industry (Exhibit A).

The Council was established as an independent, voluntary body under the auspices of the National Institute of Building Sciences, in furtherance of the objectives of the Earthquake Hazards Reduction Act of 1977 (Public Law 95-124) and in support of the President's National Earthquake Hazards Reduction Program (June 22, 1978).

The Council's objectives are:

a. promote the development of seismic safety provisions suitable for use throughout the United States;

b. recommend, encourage, and promote the adoption of appropriate seismic safety provisions in voluntary standards and model codes;

c. assess implementation progress by Federal, State, and local regulatory and construction agencies;

d. identify opportunities for the improvement of seismic regulations and practices and encourage public and private organizations to effect such improvements;

e. promote the development of training and educational courses and materials for use by design professionals, builders, building regulatory officials, elected officials, industry representatives, other members of the building community and the public;

f. provide advice to governmental bodies on their programs of research, development, and implementation; and

g. periodically review and evaluate research findings, practice, and experience and make recommendations for incorporation into seismic design practices. (Exhibit C)

The foregoing objectives are consistent with those of the Earthquake Hazards Reduction Act of 1977 and intended to support achievement of the Act's objectives.

The first specific task to be undertaken by the Council is to lead the extensive planned review of the ATC provisions and test procedures. It is important to note that the Council has not been formed to replace the initiatives of its member organizations, but is to provide a national forum where its members can develop seismic design provisions that are responsive to the public's interest. This is a unique undertaking in the building community for which I know of no precedent in any area. The opportunity for different groups to consider the merits of proposed provisions before they are incorporated into a code or national standard and thus (without the usual heated adversary climate) should substantially improve the process of reaching consensus views which provide appropriate and effective public earthquake building regulations.

The Building Seismic Safety Council is already engaged in carrying out its overview and technical responsibilities related to the National Bureau of Standards work on the Tentative Provisions for the Development of Seismic Regulations in Buildings. Voluntary private funds for this BSSC activity will not be sufficient to complete its part of the Applied Technology Council/National Bureau of Standards/Building Seismic Safety Council (ATC/NBS/BSSC) program and the Council has submitted a proposal for partial funding to the Federal Emergency Management Agency.

It is expected that the voluntary in-kind services and technical expertise will far exceed the funds requested to complete the Council's work responsibilities on this program.

Mr. Chairman, we believe that the objectives established under the Earthquake Hazards Reduction Act are sound and that the programs pursued by the National Science Foundation and the U. S. Geological Survey for research are essentially sound.

In cooperation with the Federal Emergency Management Agency and other Federal agencies the Building Seismic Safety Council has embarked upon a challenging program to substantially improve the building codes and standards and allied professional practices for earthquake safety throughout the country, and we are optimistic that we can achieve much of the national purpose in this effort.

A major concern that we wish to bring to your special attention during your reconsideration and reauthorization of the Earthquake Hazards Reduction Act is the imperative placed behind making substantive improvements in the public safety. Unless there is a concerted applications effort there is some doubt whether both the objectives of the Act and of the Building Seismic Safety Council will be realized in a timely manner.

We in the private sector will appreciate the opportunity to cooperatively address important national public safety issues posed by earthquakes and look forward to a successful relationship with the Federal agencies and departments in these matters.

I would be pleased to respond to any questions you may have.

Attachments

Exhibit A - BSSC Membership List (as of November 1979).
Exhibit B - BSSC Board of Direction and Officers
Exhibit C - BSSC Charter, Organizational Rules & Procedures

December 1979

## BUILDING SEISMIC SAFETY COUNCIL
## MEMBERSHIP LIST

EXHIBIT A

| Organization | Representative |
|---|---|
| Portland Cement Association | W. Gene Corley |
| Insurance Services Office | Karl Steinbrugge |
| American Society of Plumbing Engineers | Stephen D. Heath |
| Gypsum Association | Herbert B. Carlsen |
| National Association of Housing & Redevelopment Officials | Bernard Cummings |
| Council of American Building Officials | Vincent Bush |
| American Railway Bridge & Bldg. Assn. | Walter C. Sturm |
| Flat Glass Marketing Assn. | Joseph Solomon |
| National Council of Architectural Registration Boards | Samuel T. Balen |
| Concrete Reinforcing Steel Institute | Paul F. Rice |
| Structural Engineers Assn. of Washington | Christian Birkeland |
| Building Officials & Code Adminstrators | Gerald H. Jones |
| Western States Council of SEA | Harry H. Mejdell |
| American Consulting Engrs. Council | Warner Howe |
| National Assn. of Miscellaneous Ornamental & Architectural Products Contractors | Robert G. Thomas, Jr. |
| Structural Engineers Assn. of Idaho | David K. Bennion |
| Rack Manufacturers Institute | Herbert Klein |
| Structural Engrs. Assn. of Central California | John Schroeter |
| Structural Engineers Assoc. of California | Ajit S. Virdee |
| American National Standards Association | Joseph Stein |
| National Conference of States on Building Codes and Standards | Donald F. Pinkerton |
| National Automatic Sprinkler & Fire Control | William R. Goss |
| Building Owners & Mangers Assn | Neal D. Houghton |
| American Institute of Steel Construction | William A. Milek |
| International Assn of Electrical Inspectors | G. S. Golovko |
| Steel Plate Fabricators Assn, Inc. | Norman K. Cohn |
| American Concrete Institute | Samuel J. Henry |
| National Forest Products Association | Robert A. Hewett |
| Building Research Advisory Board | J. H. Wiggins |
| National Concrete Masonry Association | Mark B. Hogan |
| Applied Technology Council | Roland L. Sharpe |
| Brick Institute of America | Alan H. Yorkdale |
| Association of Engineering Geologists | Gerald H. Fogle |
| American Plywood Association | Daniel H. Brown |
| American Society of Civil Engineers | Henry J. Degenkolb |
| Southern Building Code Congress | William J. Tangye |
| National Association of Home Builders | David E. Johnson |
| American Insurance Association | Michael Sbaglia |
| American Iron and Steel Institute | Ivan M. Viest |
| Assn. of Wall & Ceiling Industries | Joe M. Baker |
| National Academy of Code Administrators | James M. Hicks, Jr. |
| National Elevator Industry, Inc. | Ralph Rogers |
| Prestressed Concrete Institute | Daniel P. Jenny |
| Structural Engineers Assn. of Arizona | Robert W. Johnson |
| Structural Engineers Assn. of N. Calif. | Eric Elsesser |

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|---|---|
| International Conference of Bldg. Officials | D. R. Watson |
| Interagency Committee on Seismic Safety in Construction | Charles Thiel |
| Structural Engineers Assn. of So. Calif. | Hans Steinmann |
| American Institute of Architects | Christopher W. Arnold |
| Building & Construction Trades Dept., AFL-CIO | Robert Georgine |
| Earthquake Engineering Research Institute | Roy Johnston |
| Assoc. General Contractors of America | William A. Campbell |
| National Institute of Building Sciences | Charlene Sizemore |
| Concrete Masonry Assn. of Calif. & Nevada | Stuart Beavers |
| Association of Major City Bldg. Officials | Jack Fratt |

FEBRUARY 1980

EXHIBIT B

## BOARD OF DIRECTION

## BUILDING SEISMIC SAFETY COUNCIL

CHAIRMAN

William W. Moore
Dames and Moore
500 Sansome Street
San Francisco, CA 94111
(415) 433-0700

VICE CHAIRMAN

Neal D. Houghton, Manager
Codes and Regulations
Building Owners & Managers Assn.
2907 E. Fairmount
Phoenix, Arizona 85016
(602) 956-9436

(Representing BOMA)

SECRETARY

Alan H. Yorkdale, Director
Engineering & Research
Brick Institute of America
1750 Old Meadow Road
McLean, VA 22102
(703) 893-4010

(Representing BIA)

MEMBERS

Christopher W. Arnold, President
Building Systems Development Inc.
120 Broadway
San Francisco, CA 94111
(415) 434-3830

(Representing AIA)

Vincent R. Bush
Assistant Technical Director
International Conference of
Building Officials
5360 So. Workman Mill Road
Whittier, CA 90601
(213) 699-0541

(Representing CABO)

William A. Campbell, President
Campbell Construction Company
2120 20th Street
P. O. Box 390
Sacramento, CA 95802
(916) 452-5371

(Representing AGC)

W. Gene Corley, Director
Engineering Development Dept.
Portland Cement Association
5420 Old Orchard Road
Skokie, ILL 60077
(312) 966-6200

(Representing PCA)

Henry J. Degenkolb
H. J. Degenkolb & Associates
350 Sansome Street
San Francisco, CA 94104
(415) 392-6952

(Representing ASCE)

**MEMBERS**

Robert A. Georgine, President
Building & Construction Trades Dept.
AFL-CIO
815 16th Street, N.W.
Washington, D. C. 20006
(202) 347-1461
(Representing AFL-CIO)

Robert A. Hewett, Director
Engineering Services
National Forest Products Association
1619 Massachusetts Ave., N.W.
Washington, D. C. 20036
(202) 797-5880
(Representing NFoPA)

Roy G. Johnston
Brandow & Johnston Associates
1660 W.3rd Street
Los Angeles, Calif. 90017
(213) 484-8950
(Representing EERI)

Donald F. Pinkerton, Exec. Director
National Conference of States on
Building Codes and Standards
1970 Chain Bridge Road
McLean, VA 22101
(703) 790-5750
(Representing NCSBCS)

Charlene F. Sizemore
410 Twelfth Avenue
Huntington, W. Va. 25701
(304) 523-4558
(Representing NIBS/COCO

Ivan M. Viest, Asst. Manager
Sales Engineering
Bethlehem Steel Corporation
Bethlehem, PA 18016
(215) 694-2579
(Representing AISI)

Ajit S. Virdee, Associate Professor
Chairman, Dept. of Civil Engineering
California State University
Sacramento, CA 95819
(916) 466-6128
(Representing SEAOC)

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ACTING EXEC.
DIRECTOR

William G. Kirkland
National Institute of Building Sciences
1015 15th Street, N.W.
Washington, D. C. 20005
(202) 347-5710

EXHIBIT B

# BUILDING SEISMIC SAFETY COUNCIL

1015 15th Street, N.W., Suite 700
Washington, D.C. 20005
(202) 347-5710

## BIOGRAPHICAL INFORMATION
## BSSC BOARD OF DIRECTION

| | |
|---|---|
| WILLIAM W. MOORE<br>Chairman | Founding Partner of Dames & Moore - Foundation Engineering. Expertise: Foundation Engineering, Soil Dynamics and Seismology and the development of innovative applications of soil mechanics theories to many aspects of civil engineering practice. Former staff member U.S. Corps of Engineers; U.S. Coast and Geodetic Survey. Professional Affiliations: Vice President of Zone IV, 1976-78, American Society of Civil Engineers; Honorary member, President, 1947 Structural Engineers Association of Northern Calif.; Honorary member, Structural Engineers Association of Southern Calif.; President, 1964-65, American Consulting Engineers Council; President, 1970-72, Federation Internationale des Ingenieurs-Conseils; President, 1973-74, Applied Technology Council; Chairman, 1979, Building Seismic Safety Council; Member, Earthquake Engineering Research Institute; Society of Military Engineers; American Society for Testing and Materials; Fellow, Institution of Civil Engineers (England); Member, National Academy of Engineering. B.S. and M.S. degrees in civil engineering, California Institute of Technology. Author of numerous technical publications related to earthquake engineering and recipient of several achievement awards in the field of engineering. |
| NEAL D. HOUGHTON<br>Vice-Chairman | Manager, Codes and Regulations, Building Owners and Managers Association International, Washington, D.C., Past Executive Director, BOMA of Phoenix, AZ. Mechanical Engineer and Member, National Society of Professional Engineers. Active in Model Code Committees. Member, Panel of Arbitrators, American Arbitration Assn. |
| ALAN H. YORKDALE<br>Secretary | Director of Engineering and Research, Brick Institute of America, McLean, Va. Studied Civil Engineering at Montgomery College, George Washington University, and the University of Virginia. Member: American Society of Civil Engineers, American Concrete Institute, Prestressed Concrete Institute, American Society for Testing and Materials, National Society of Professional Engineers, International Masonry Industry All-Weather Council and National Fire Protection Association. Representative to: International Council of Building Officials, Building Officials Conference of America, Southern Building Code Congress, American National Standards Institute, and NIBS Consultative Council. Author of numerous technical papers and articles on subjects of design and construction with masonry. |

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|---|---|
| **CHRISTOPHER ARNOLD** | President, Building Systems Development, Inc., San Francisco, CA, architectural firm specializing in research and analysis. Member, American Institute of Architects, Royal Institute of British Architects, Earthquake Engineering Research Institute. Member, Advisory Committee, National Science Foundation, Earthquake Hazards Mitigation Program. Member, American Section of the International Solar Energy Society, Inc. Visiting lecturer, Department of Architecture, University of California, Berkeley. |
| **VINCENT R. BUSH** | Assistant Technical Director, International Conference of Building Officials; Member, Earthquake Engineering Research Institute; Fellow, American Society of Civil Engineers; Member, Seismological Society of America; Member, Structural Engineers Association of Southern California; Member, National Fire Protection Association; Member, President's Advisory Group on Earthquake Prediction and Hazard Mitigation; Member, Seismic Risk Working Group, U.S. Geological Survey. Active in building code development particularly as it relates to earthquake resistance of buildings. |
| **WILLIAM A. CAMPBELL** | President, Campbell Construction Company of Sacramento, Calif. Past President, Associated General Contractors of California. Member, American Society of Civil Engineers, Structural Engineers Association of Central California. Member, Board of Directors, Beaver Insurance Company, San Francisco. Member, Board of Directors, Capital Federal Savings and Loan Co., Sacramento. |
| **W. GENE CORLEY** | Divisional Director, Engineering Development Division, Portland Cement Association, Skokie, Ill; Fellow, American Concrete Institute and Member, Committee on Standard Building Code, Technical Activities Committee, and other technical committees; Vice Chairman, Chicago Committee on High Rise Buildings; Former Secretary, Reinforced Concrete Research Council; Member, Technical Activities Board of Post-Tensioning Institute; Member, International Association for Bridge and Structural Engineering; Member, Prestressed Concrete Institute; Member, RILEM; author of many articles on earthquake resistance of reinforced concrete structures; Registered Structural Engineer and Professional Engineer in several states. |

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|---|---|
| HENRY J. DEGENKOLB | Chairman of the Board, H. J. Degenkolb, Consulting Engineers, San Francisco, CA. Honorary member of the American Society of Civil Engineers; Member of the National Academy of Engineering; Seismological Society of America; American Concrete Institute; American Society for Testing and Materials. Member and Past President of the Structural Engineers Assn. of California, San Francisco Section of the American Society of Civil Engineers. Former member of the Executive Committee, Structural Division, American Society of Civil Engineers, presently Secretary of the Technical Council on Codes and Standards. Member and Past President of the Earthquake Engineering Research Institute, Member of the State of California Building Standards Commission, Member of the Board of Examiners, City and County of San Francisco, Member of Code Code, San Francisco Chamber of Commerce; Former member State of California Seismic Safety Commission, currently serving on an Advisory Committee to the Commission. |
| ROBERT A. GEORGINE | President, Building and Construction Trades Department, AFL-CIO, Washington, D. C. Member, Building Research Advisory Board, HUD Research Task Force on Housing Costs, AFL-CIO Standing Committee on Housing, FEA Construction Advisory Committee, Department of Labor Employee Welfare and Pension Plan Advisory Council, Department of the Interior Outer Continental Shelf Advisory Board, President's Committee on the Employment of the Handicapped. Member, Board of Directors, Alliance to Save Energy; Member, Board of Directors, National Housing Conference; Member, Board of Directors, Atomic-Industrial Forum. |
| ROBERT A. HEWITT | Director, Engineering Services, National Forest Products Association, Washington, D. C. |
| ROY G. JOHNSTON | Principal, Brandow and Johnston Associates, Consulting Engineers, Los Angeles. Past President, Structural Engineers Association of California; Past President, California State Board of Registration for Professional Engineers; Member, Veterans Administration Advisory Committee of Structural Stability; Member, Advisory Committee for Earthquake Hazards Reduction Program; Director, Earthquake Engineering Research Institute; Director, Building Seismic Safety Council; Fellow, American Society of Civil Engineers; Member, American Concrete Institute; Member, Consulting Engineers Council of California; Fellow, Institute for the Advancement of Engineering; Registered California Structural Engineer No. 332 State of California. |

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|---|---|
| DONALD F. PINKERTON | Executive Director of the National Council of States on Building Codes and Standards (NCSBCS) since August 1976. In this capacity, he is responsible for maintaining liaison with all other building code and building code related organizations. He serves as the NCSBCS representative to a number of organizations including the model code groups. He has the final responsibility for negotiating and executing all contractual agreements which include, but are not limited to, the HUD Mobile Home Contract and the DOE Energy Contract. Former Director of the California Department of Housing and Community Development. He was also very active in local government which resulted in his being elected Mayor for the City of Fairfield, Calif. |
| CHARLENE F. SIZEMORE | Statistical Engineer. Chairman, Consumer Affairs Advisory Council, State of West Virginia, Huntington, W. Va. Active in consumer group related services. Member, Consumer Advisory Council Underwriters Laboratories. |
| IVAN M. VIEST | Assistant Manager, Sales Engineering Division, Bethlehem Steel Corporation. Member of National Academy of Engineering. Past Vice President of American Society of Civil Engineers. Member, Committee on Building Specification of American Institute of Steel Construction. Chairman, Seismic Subcommittee of American Iron and Steel Institute. Active in structural engineering research, specifications and management. |
| AJIT S. VIRDEE | Professor of Civil Engineering, California State University, Sacramento, CA. Partner of Rumberger, Haines, Virdee & Associates, Consulting Civil and Structural Engineers, Sacramento. Past-President of Structural Engineers Association of Californoe. Past Chairman, Seismology Committee, Structural Engineers Association of CA. Member, Board of Directors, Applied Technology Council. Past Chairman, Western States Council of Structural Engineers Associations. Member, Board of Directors, Structural Engineers Association of California. Past Chairman, Depart. of Civil Engineering, California State University, Sacramento. Fellow, American Society of Civil Engineers. Member, Earthquake Engineering Research Institute. Registered Civil and Structural Engineer in the State of California. Registered Professional Engineer, Illinois. Master of Science, University of Illinois, Urbana. Doctor of Engineering, University of California, Davis. Active in many technical and professional committees. |
| WILLIAM G. KIRKLAND, P.E.<br>Acting Executive Director | Consulting Engineer. Former Vice President of Building Research and Technology of American Iron and Steel Institute. Member and Past Chairman of American Society of Civil Engineers Technical Council on Codes and Standards. Member of the Council of American Building Officials Advisory Council, Member and Past Chairman of the AIA Architects and Engineers Joint Committee on Building Codes and Standards. Fellow and Life Member of the American Society of Civil Engineers. Former member of the President's Task Force on Low Income Housing; Structural Engineers Association of California; Board of Directors of American National Standards Institute; Board of Directors of Building Research Advisory Board of the National Academy of Sciences; American Welding Society; and numerous technical committees and scientific missions related to earthquake engineering. |

EXHIBIT C

# BUILDING SEISMIC SAFETY COUNCIL

## CHARTER

## ORGANIZATIONAL RULES AND PROCEDURES

## ARTICLE I. CHARTER

### Section 1. Purpose and Scope

The purpose of the Building Seismic Safety Council (Council) is to enhance the public's safety by providing a national forum to foster improved seismic safety provisions for use by the building community. For the purposes of the Council, the building community is taken to include all those involved in the planning, design, construction, regulation, and utilization of buildings.

The scope of the Council's activities encompasses seismic safety of building-type structures with explicit consideration and assessment of the social, technical, administrative, political, legal, and economic implications of its deliberations and recommendations.

Achievement of the Council's purpose is a concern shared by all in the public and private sectors. Council activities will provide an opportunity for participation by those at interest, including local, State, and Federal Government, voluntary organizations, business, industry, the design professions, the construction industry, the research community and the public. Regional and local differences in the nature and magnitude of potentially hazardous earthquake events require a flexible approach adaptable to the relative risk, resources and capabilities of each community.

The Council recognizes that appropriate earthquake hazard reduction measures and initiatives should be adopted by existing organizations and institutions and incorporated into their legislation, regulations, practices, rules, codes, relief procedures and loan requirements, whenever and wherever possible, so that these measures and initiatives become part of established activities rather than being superposed as separate and additional.

### Section 2. Establishment and Duration

The Council is established as an independent, voluntary body under the auspices of the National Institute of Building Sciences (Institute) for an initial period of four years.

### Section 3. Statutory Authority

The Council is established under the authority of the Housing and Community Development Act of 1974, (Public Law 93-383), Title VIII, which established the Institute, in furtherance of the objectives of the Earthquake Hazards Reduction Act of 1977 (Public Law 95-124), and in support of the President's National Earthquake Hazards Reduction Program, June 22, 1978.

### Section 4. Objectives

To achieve its purpose, the Council shall:

a. promote the development of seismic safety provisions suitable for use throughout the United States;

b. recommend, encourage, and promote the adoption of appropriate seismic safety provisions in voluntary standards and model codes;

c. assess implementation progress by Federal, State, and local regulatory and construction agencies;

d. identify opportunities for the improvement of seismic regulations and practices and encourage public and private organizations to effect such improvements;

e. promote the development of training and educational courses and materials for use by design professionals, builders, building regulatory officials, elected officials, industry representatives, other members of the building community and the public.

f. provide advice to governmental bodies on their programs of research, development, and implementation; and

g. periodically review and evaluate research findings, practice, and experience and make recommendations for incorporation into seismic design practices.

## ARTICLE II. MEMBERSHIP

### Section 1. Qualifications

The membership of the Council is open to all professional societies, and labor, trade, model code, voluntary standards, public interest, and public agency organizations which have an interest in the Council's purpose. Organizations not meeting these requirements, but nonetheless interested in pursuing the purpose and objectives of the Council may petition and be elected to membership by the Board of Direction (Board). The Council will make a reasonable effort to create and maintain a membership that is a broad and balanced representation of all segments of the building community and the public interest.

### Section 2. Admission of Members

Qualified organizations will be admitted as members upon filing a completed Membership Application with the Secretary of the Council and approval by the Board of Direction. Member organizations will designate a representative and an alternate authorized to act on behalf of the organization. Any change in the authorized representative or alternate will be accomplished by filing a notice of such change with the Secretary.

### Section 3. Rights of Members

Each member shall be entitled to one vote on all matters brought before the Council, and shall receive notice of meetings, minutes of such meetings, and other appropriate documentation of the affairs of the Council. Each person serving on any committee, panel, or other unit of the Council shall be entitled to one vote on all matters before that unit. Alternates of representatives elected to the Board are not authorized to act on matters coming before that body. Any change in the authorized representative or alternate will be accomplished by filing a notice of such change with the Secretary.

### Section 4. Removal of Members

Members may be removed at the discretion of 2/3 of the Board after failure to participate in the activities of the Council.

## ARTICLE III. CONDUCT OF COUNCIL BUSINESS

### Section 1. Policy

The business of the Council and its subunits shall be conducted in accord with the policies, rules, and procedures established by vote of the members of the Council.

### Section 2. Meetings

The Council shall hold at least one meeting annually that shall be designated as its annual meeting. The annual meeting shall be held preferably during November of each year with at least thirty (30) days notice. Other meetings will be called by the Chairperson of the Council upon at least fifteen (15) days written notice to all members. These meetings shall be called by the Chairperson upon majority vote either of the Council or its Board or by petition of at least twenty (20) percent of the members, with the same notice.

### Section 3. Rules of Order

"Roberts' Rules of Order" shall govern the transaction of all business before the Council.

### Section 4. Quorum

A quorum for conduct of the Council's business shall be at least one-third (1/3) of the members of the Council. The lack of a duly constituted quorum shall not preclude those in attendance from conducting Council business provided that the minutes are confirmed by mail by the Council in accord with the requirements for mail ballot.

### Section 5. Voting

See Articles IV, V, and VI for the procedures for the election of the Board, Officers, and Nominations Committee.

Section 5. Voting (Cont'd.)

All matters submitted to a vote during meetings of the Council shall be considered passed if a simple majority of those present vote in favor. Mail ballots to the full membership of the Council shall be required in the following instances:

a. All amendments to Rules and Procedures (see Article XI).

b. All matters petitioned by ten (10) members. A voice or written vote for mail ballot on a matter during a regular meeting by ten (10) members shall be considered an acceptable petition for mail ballot.

c. All matters called for by a simple majority of the Board.

When a mail ballot is called for, the following shall apply:

a. Ballots shall provide four alternatives: Yes; Yes with reservations; No; and, Not voting. "Yes with reservations" and "No" votes must be accompanied by full and sufficient basis for the vote. A "No" vote should be accompanied by specific suggestions for change, if those changes would change the negative to affirmative.

b. Closing date shall be thirty (30) days after date mailed.

c. Ballots shall be reviewed and counted by a Tellers Committee appointed by the Chairperson, which shall attempt to resolve all "Yes with reservations" and "No" votes. All such votes and accompanying basis for the vote shall be distributed to the full voting membership.

d. A two-thirds (2/3) affirmative ("Yes" and "Yes with reservations") vote of those received by the closing date shall be sufficient to record a favorable vote, provided at least one half of the member's ballots are returned.

e. All votes and supporting materials shall be filed with the Secretary of the Council.

The results of votes by the full Council shall not be considered binding on organizations participating as members of the Council, but shall be binding with respect to the business of the Council.

Section 6. Minutes and Annual Report

Minutes shall be kept of all meetings of the Council and its constituent groups and shall be approved by the members attending the meetings. Approved minutes shall be filed with the Secretary of the Council. The Secretary shall submit a written annual report to the membership following the close of the fiscal year and not later than at the ensuing Annual Meeting.

## ARTICLE IV. BOARD OF DIRECTION

### Section 1. Duties and Responsibilities

The Board shall: a) administer the affairs of the Council in accordance with policy as approved by the Council; b) explore matters and initiate and carry out all activities within the Council's sphere of interest; c) assign responsibility to the senior staff officer, all committees, panels, and other units of the Council necessary to the conduct of the Council's business; d) review and approve for public release all reports and other documents containing findings, conclusions, and recommendations of the Council; e) approve the terms and conditions of all contracts on behalf of the Council; and f) approve applications for Council membership.

### Section 2. Membership

The Board shall consist of not less than nine (9), nor more than fifteen (15) elected persons, plus a Chairperson. The Board members will be individuals selected from the designated representatives of the membership of the Council. The Chairperson shall be selected by the Board.

An interim Board will be appointed by the Institute to serve until the first Annual Meeting of the Council with due consideration to providing broad representation and balance from all segments of the building community and the public interest.

Membership of all succeeding Boards also shall be broadly representative of all segments of the building community and the public interest.

At any time a Board member other than the Chairperson ceases to be the representative of his or her organization, the member shall be deemed to have resigned from the Board.

### Section 3. Terms

The term of members of the first elected Board shall be chosen by lot, with one-third for a term of one (1) year, one-third for a term of two (2) years, and one-third for a term of three (3) years. Thereafter, one-third of the members will be elected annually for a term of three (3) years. No individual shall serve for more than six (6) successive years.

### Section 4. Vacancies

Vacancies may be filled by the Board until the next annual meeting, at which time an election shall be held to fill the unexpired term.

### Section 5. Recall

Any member of the Board can be removed by simple majority vote of the Council's membership, upon petition by twenty (20) per cent of the members of the Council.

Section 6. Meetings

The Board shall hold at least three (3) other meetings in addition to a meeting in conjunction with the Annual Meeting of the Council. Other meetings may be called by the Chairperson, upon majority vote of the Board, or upon written request of a majority of the Board, with ten (10) days' written notice.

Section 7. Quorum

A quorum for conduct of the business of the Board shall be a simple majority.

## ARTICLE V. OFFICERS

Section 1. Officers

The officers of the Board, who also shall be the officers of the Council, shall be the Chairperson, the Vice Chairperson, and the Secretary. The Treasurer and Comptroller of the Institute shall function as non-voting officers in these capacities for the Council.

Section 2. Selection of Officers

The Chairperson shall be selected by majority vote of the Board from individuals who are not necessarily the designated representatives of member organizations. For purposes of the Council, the Chairperson is a member of the Council but shall not be the representative or alternate of any specific member organization during his term of office. The Vice Chairperson and Secretary shall be selected by majority vote of the Board from among its members.

Each such officer shall hold office until a successor shall have been duly elected and qualified, or until resignation or removal by the Board.

Section 3. Terms

The Chairperson, Vice Chairperson, and the Secretary shall serve at the pleasure of the Board for a term of one (1) year beginning immediately following the Annual Meeting. No individual shall serve in any one office for more than two consecutive one (1) year terms. Vacancies shall be filled for any unexpired term by the Board.

The Treasurer and Comptroller shall serve for terms consistent with their tenure in the same office in the Institute.

Section 4. Duties and Responsibilities

The duties and responsibilities of officers shall be as follows:

a. Chairperson - The Chairperson shall serve as the Chief Executive Officer and principal spokesperson for the Council, and preside at all meetings of the Board and of the Council. The Chairperson shall appoint, in counsel with the Board, all committees, panels and other units of the Council and verify the review and approval of all reports and other documents for public release on behalf of and with the approval of the Board.

b. Vice Chairperson - The Vice Chairperson shall act for the Chairperson in all respects during the temporary absence of the Chairperson.

c. Secretary - The Secretary shall: 1) see that all notices of meetings are duly given; 2) keep or cause to be kept all books, minutes, and other records of the activities of the Council and its Board as are required by law or by these Rules and Procedures; 3) sign such instruments as require the signature of the Secretary; and 4) in general, perform all duties incident to the Office of Secretary and such other duties as from time to time may be assigned by the Chairperson or the Board.

d. Treasurer - The Treasurer shall: 1) have charge and custody of, and be responsible for, all funds of the Council; 2) receive, and give receipts for, monies due and payable to the Council; 3) sign such documents as shall require the signature of the Treasurer; and 4) in general perform all the duties incident to the Office of Treasurer.

e. Comptroller - The Comptroller shall: 1) be the chief accounting officer of the Council; 2) keep full and accurate accounts of all assets, liabilities, commitments, receipts, disbursements, and other financial transactions of the Council; 3) cause regular audits of the books and records to be made; 4) see that all expenditures are made in accordance with procedures duly established, from time to time, by the Council with the concurrence of the Institute; 5) render financial statements at all regular meetings of the Council Board if called upon to do so, and a full financial report at the Annual Meeting of the Council; and 6) in general, perform all the duties ordinarily connected with the Office of Comptroller.

## ARTICLE VI. NOMINATIONS COMMITTEE

### Section 1. Functions

The Nominations Committee shall annually, at least sixty (60) days prior to the Annual Meeting, submit to the Secretary of the Council a balanced slate of candidates broadly representative of all segments of the building community, for election to the Board, equal to the number of vacancies to be filled. They shall also submit a slate of at least seven (7) nominees for the next Nominations Committee. In drawing-up a slate, the Nominations Committee shall first solicit recommendations from the full membership of the Council.

### Section 2. Membership

The Nominations Committee shall be composed of the five (5) nominees receiving the greatest number of votes, none of whom shall be members of the Board, nor the prior Nominations Committee. They may not nominate themselves for election to the Board or the next Nominations Committee.

## Section 3. Terms

The term of the Nominations Committee shall begin prior to June 1 of each year and shall expire with the Annual Meeting.

## Section 4. Processing of Nominations

The Secretary shall submit the slate of candidates from the Nominations Committee, with space for write-in candidates, to ballot by the full membership of the Council at least forty-five (45) days prior to the Annual Meeting. Executed ballots must be received by the Secretary at least fifteen (15) days prior to the Annual Meeting. Upon receipt of ballots, the Secretary, in concert with a Tellers Committee, shall tally the ballots, determine those elected to the Board on the basis of the largest vote, and present the vote to the Board for announcement at the Annual Meeting. In case of a tie vote that will affect the Board's composition, the Board shall fill the disputed vacancy from among the tied candidates with due regard to maintaining a balanced representation of all segments of the building community on the Board.

# ARTICLE VII. COMMITTEES

## Section 1. Operations

Committees shall function under written rules and procedures approved by the Board.

## Section 2. Term

The Board, by majority vote, may create and terminate such committees as it deems appropriate.

## Section 3. Membership

Membership on other than administrative committees need not be restricted to members of the Council.

## Section 4. Publications

Reports and other documents of all committees that are intended for public release as reports of the Council must be reviewed and approved by the Board prior to publication.

# ARTICLE VIII. FINANCIAL AFFAIRS

## Section 1. Grants, Contracts, and Donations

The Institute, on behalf of the Council, may receive grants, contracts, and donations, and may execute contracts, grants and other appropriate agreements that are approved by the Board.

### Section 2. Membership Fees

The Council may establish membership fees, and may waive these fees for particular members. The Chairperson shall not be assessed a membership fee.

### Section 3. Funds

Accountability and administration of all income and other revenues designated for support of the Council or its activities shall be the responsibility of the Institute. Such funds shall be used only to defray expenses of the Council authorized by its Board. Overhead costs of the Institute will be charged at a rate equal to that charged on other program income of the Institute. The Institute shall maintain separate accounting for the business of the Council and render an annual financial report and such other financial reports at such times as may be requested by the Council or its Board.

### Section 4. Fiscal Year

The fiscal year of the Council shall be the same as that of the Institute.

## ARTICLE IX. STAFF

### Section 1. Support Staff

The Institute shall arrange for administrative services and support staff requested by the Board. The selection, duties, responsibilities, and title of the senior staff officer shall be determined by the Board. The Council shall not retain or cause to be retained, permanent technical staff.

### Section 2. Technical Consultants

Technical Consultants to the Council, will be retained by the Institute as requested by the Council, consistent with its budget. Such consultants shall be selected and, where necessary, terminated with the concurrence of the Board.

## ARTICLE X. ADOPTION

The Council shall be considered to be formed upon adoption of this Charter and these Organizational Rules and Procedures by a two-thirds (2/3) majority of the representatives of organizations attending and voting at the organizational meeting. Thereafter, this Charter and these Organizational Rules and Procedures shall govern affairs of the Council, subject to the provisions of Article XI.

## ARTICLE XI. AMENDMENTS

Proposed amendments to any article may be offered by a written petition by twenty (20) percent of the members of the Council or by majority vote of the Board. Proposed amendments will be reviewed by the Institute to certify their compliance with statutes referenced in Article I, Section 3. prior to submission to membership for ballot. The Secretary of the Council shall cause such duly authorized proposed amendments to be submitted to the full membership for written ballot at least forty-five (45) days prior to the next Annual Meeting or special meeting called for that purpose. Votes received at least fifteen (15) days prior to the meeting shall be tallied by the Secretary in accordance with procedures established herein.

Mr. **Brown**. Thank you very much, Mr. Moore.

You know, of course, the Government couldn't afford to hire an expensive engineer like you.

Mr. **Moore**. Well, I have had a theory that if you get somebody to donate their own time, all of a sudden, things become a lot more effective; they devote more interest to it and they do it more expeditiously than if they were paid for it.

Mr. **Brown**. I guess it's an interesting coincidence that we have two of the three witnesses here from the city of San Francisco where, I presume, most of the experts in earthquakes reside; is that correct?

Mr. **Moore**. I'd like to comment on that. San Francisco and California is widely thought of as the home of earthquakes. One of the things that was done through the Applied Technology Council was to make a very serious attempt—and I think successfully—to look at the earthquake problem from a national perspective.

Most of the States in the country are subject to the possibility of damage from earthquakes. Something over 30, at least. And the work done by the Applied Technology Council did include experts from throughout the country, and Dr. Hall, of course, from Illionis is an example, but there are others. This is the thrust also of the Building Seismic Safety Council, to bring in people who are involved in the building business from all throughout the country. There's a structural engineer from Boston; there's another structural engineer from Tennessee So the purpose is to make the results of this study appropriately applicable—obviously, they will differ, but appropriately applicable throughout the country, so it's not just the California effort.

Dr. **Hall**. Mr. Chairman, you will note that I was born in Berkeley and my first 18 years were spent in California, so I am a native Californian.

Mr. **Brown**. I would like to acknowledge the fact that we have been joined by a delegation of students from California, some of whom are from my own area of Riverside. I want to welcome them here this morning, and I hope they will benefit from the experience of attending a hearing like this.

I'd like to call on Mr. Elsesser now to make a statement. Unfortunately, we have to vacate this room at 10:30, so we will have to—to the degree that any of you can return at 2:00 this afternoon, I want to pursue some of the issues which you have raised in some questions at that time, if I may.

Mr. Elsesser?

Mr. **Elsesser**. Mr. Chairman, I have submitted some written testimony, and I would like that incorporated.

Mr. **Brown**. Without objection, it will be made part of the record.

## STATEMENT BY ERIC ELSESSER ON BEHALF OF THE STRUCTURAL ENGINEERS ASSOCIATION OF NORTHERN CALIFORNIA

Mr. **Elsesser**. My name is Eric Elsesser, and I am very pleased to be here today to have the opportunity to speak as president of the Structural Engineers Association of Northern California, and for myself as a practicing structural engineer.

The past decade has seen a great step forward in the field of earthquake engineering, and especially significant has been the progress made during the past 3 years as the result of the funding of the Earthquake Hazard Reduction Act.

The many years in which the engineering profession worked with inadequate funding in this area long delayed our understanding of the earthquake phenomenon and the development of proper engineering solutions.

We have gained good momentum now and we hope to maintain that momentum to achieve the goal of economical and safe earthquake-resistant structures for all regions of the country.

From the structural engineering viewpoint, the Earthquake Hazard Reduction Act has produced especially valuable results in four specific areas. First, the acquisition of records of earthquake motion, which are essential to an understanding of how the ground shakes and the structures respond.

The second, the testing of structural assemblies to determine how our buildings behave when they are subjected to extreme forces; third, the application of our experience and research data to the development of building standards such as the ATC-3 document.

And fourth, the communication of ideas and information.

I'd like to briefly comment on each of these.

The first area concerns the obtaining of strong motion records of ground shaking and structures subject to that shaking. The efforts of the U.S. Geological Survey Seismic Engineering Branch and the State of California have produced excellent records on recent California quakes.

Fine records were obtained specifically in the Imperial Valley recently in the earthquake at the end of last year, and for the first time, the structural behavior of a complete building was comprehensively recorded for our study.

The expanded recording instrument arrays funded by the National Science Foundation are essential so that enough records can be obtained for a complete analysis of ground motion. For too many years we have had no data, or only partial data, and our progress has been very slow. With these expanded networks, both in this country and abroad, and properly maintained, we can look forward to real information so that our engineering judgments will now be based on fact.

The earthquake, it should be understood, is the real laboratory, and from a structural engineer's standpoint, data missed during a major earthquake is lost forever, and the long wait until the next earthquake only delays our understanding and development of adequate solutions.

The second point involves the analytical and physical experimentation to test materials and structural assemblies so to understand their performance at high stress levels, those that are experienced during actual earthquakes.

It has not been reasonable to completely study real buildings during actual earthquake motion. It is consequently necessary to represent the structure in a laboratory and to subject it to forces nearly equal to real earthquake loads as possible in order to observe the destructive behavior experience in earthquakes.

Our understanding of the structures we design has improved because of recent National Science Foundation funding of large-scale cyclic and dynamic shaking tests. Significant research on large-scale assemblies has been carried out in reinforced concrete sheer walls and structural steel frames at the University of California at Berkeley and on concrete assemblies at the University of Texas, University of Illinois and the Portland Cement Association. And a new concept for steel bracing, as a result of this funding, was developed at the University of California at Berkeley, and this system is now being used on three actual projects in California under construction at this time. So there is a real payoff from some of the research.

We are beginning to see results of this research work, and the research worthwhile; the investment is large, but the results are valuable to the engineering profession.

After physical testing of assemblies, the analytical methods need to be developed to enable the experimental data to be translated by the engineering profession to the actual design of buildings. The National Science Foundation has also supported the development of computer programs in this area which have been invaluable to the design and this is an ongoing and continuing process.

The third area where research effort has been productive is that of applying the collective experience to the development of standards. The Structural Engineers Association of California has for many years voluntarily developed seismic design standards and it is acknowledged worldwide, and it continues to do so. But the recent explosion of information and the awareness of the seismic design problem goes beyond California and led to the NSF funding of the NBS project by the Applied Technology Council, which produced the ATC-3 document.

This document was published in 1978 and represents the collective knowledge and experience of nationwide experts in engineering and, as such, is the springboard for future seismic design standards which can be adopted by jurisdictions throughout the country.

The ATC-3 document, in my estimation, is a major achievement, and is currently being reviewed by the Building Seismic Safety Council and will need to be tested by practicing design engineers. This is a current ongoing effort which will require several years.

Nevertheless, immediate results are visible. For example, discussions have been stimulated in the masonry industry to develop a national masonry design standards, something that has not existed to this point. Load factor concepts of all materials are being studied; additional factors previously ignored are being directly addressed now, such as building configuration, the performance of the nonstructural elements, and soils effects.

In addition, the ATC-3 provisions are currently being reviewed for possible adoption by several code-writing authorities. One, for example, the city of San Francisco, which is considering adopting all or portions of the document in its forthcoming building code. The ATC-3 provisions are being reviewed by large corporations that have internal large building programs as standards for their corporation.

The fourth benefit of the Earthquake Hazard Reduction Act has been the creation of an attitude in the profession of being receptive to change The National Science Foundation has sponsored numerous workshops for specialists working in the earthquake engineering field where research needs and future directions have been discussed A byproduct of these discussions is the development of new concepts and the exchange of ideas.

I'd like to say that the structural engineers have a long tradition in California, especially of volunteer professional effort. This was referred to a moment ago. Especially in the seismic engineering field. And most of our professional accomplishments to date in the earthquake field have been achieved without compensation.

Our profession has visited earthquake-damaged sites to observe the effects of major ground motion; we have generated studies and reviewed research; we have advised numerous policy groups. We look forward to continuing this volunteer effort, but the basic and applied experimental research and education should continue and should be funded.

The momentum I referred to earlier must be maintained in several areas if we are to achieve earthquake hazard reduction. Although the list of research efforts is long, if I had to prepare a short list, my list would include these following eight points:

One, continuation of the strong-motion program with both domestic and foreign sites is appropriate to provide the basic data for analytical studies of building earthquake response. This program, as in the past, must be made continuing and an ongoing effort.

Two, continuation of the engineering experimentation, especially with large-scale assemblies under cyclic loading and dynamic shaking to verify concepts and to increase our understanding of the performance of structures under extreme loading. Moreover, the results of the experiments need to be reduced and summarized so that they can be utilized by the practicing design engineer.

Three, continuation of the analytical studies to reconcile experimental test recults, observe behavior in real earthquakes, and mathematical models to enable the practicing design engineer to utilize that information.

Four, continuation of studies to verify the provisions of the ATC-3 document.

Five, continuation of studies of existing hazardous buildings to develop methods of reinforcing these structures to reduce the hazard they pose to the public, and studies in that area should also include social and economic consequences of mandated seismic strengthening of existing buildings.

Six, encouragement of studies of new structural concepts for seismic resistance. Structures which efficiently absorb earthquake energy or which are isolated from the ground shaking have a high potential for yielding economical structural solutions. This work is just beginning, and it is very, very promising.

Seven, promotion of communication and cooperation between architects and engineers involved in the design of buildings in seismic areas, with the goal of educating both design professions in this respect. Special emphasis should be placed on the importance of selecting appropriate building configurations for favorable seismic response, and on the proper design of nonstructural components of a building, such as ceilings, partitions, cladding and service systems.

Eight—and the most important in my mind—is the general dissemination of information gained from the research programs. This requires translating the information so that it can be utilized in professional practice. An education program aimed at engineers, architects, building owners, building officials, inspection agencies and contractors, which includes seminars, design guides, teaching aids, and, where possible, visits to post-earthquake damage, are all important components of energy dissemination.

I can summarize that our goal of structural engineers is to provide safe buildings for the public and economical structures which attempt to balance the needs of society with our limited and costly natural resources so as to yield cost-effective construction.

I am optimistic about the future in this field, and I believe that our progress to date is in large measure due to our current funding level.

Thank you.

[The complete prepared statement of Mr. Eric Elsesser is as follows:]

# STATEMENT OF ERIC ELSESSER
# CONCERNING THE
# EARTHQUAKE HAZARD REDUCTION ACT OF 1977

## U.S. HOUSE OF REPRESENTATIVES
## SUBCOMMITTEE ON SCIENCE RESEARCH AND TECHNOLOGY
## FEBRUARY 28, 1980

I am very pleased to be here and to have the opportunity to speak on behalf of the Structural Engineers Association of Northern California, and for myself as a practicing Structural Engineer concerned with earthquake hazard reduction.

The past decade has seen a great stride forward in the field of earthquake engineering, and especially significant has been the progress made possible during the past three years, as a result of the funding of the Earthquake Hazard Reduction Act of 1977. The many years in which the engineering profession worked without adequate funding in the earthquake area long delayed our full understanding of the earthquake phenomenon and the proper solution to the engineering design problem. We want to maintain the good momentum we have gained in the past and achieve the goal of economical and safe earthquake resistant structures for all seismic regions of this country.

From the structural engineering viewpoint, the Earthquake Hazard Reduction Act of 1977 has produced valuable results in four separate areas: first, the acquisition of records of earthquake motion which are essential to an understanding of how the ground shakes and how structures respond to that shaking; second, the testing of structural assemblies to determine how our buildings behave when subjected to extreme forces; third, the application of our experience and test data to development of building codes where the information gained can be used by practicing engineers; fourth, the transmission of all the information about ground motion, materials tests and codes to the user. I would like to develop my thoughts on these four areas, which are critical to the practice of earthquake engineering.

The first area concerns obtaining strong motion records of the ground shaking and of structures subject to that shaking. The efforts of the U.S. Geological Survey, Seismic Engineering Branch, and the State of California, have produced excellent records in recent California earthquakes, as a result of the expanded instrumentation programs. Fine records were obtained in the El Centro earthquake of 1979, and, for the first time, the structural behavior of a complete building was comprehensively recorded for our study.

The expanded recording instrument arrays funded by the National Science Foundation and the U.S. Geological Survey are essential, so that enough records can be obtained for a complete analysis of ground motion. For too many years, we have had no data or only partial data, and our progress has been slow. With expanded networks, both in this country and abroad, properly maintained, we can look forward to real information, so that our engineering judgments will be based on fact. The earthquake is the real laboratory, and, from the structural engineering standpoint, data missed during a major earthquake is lost, and the long wait until the next earthquake only delays our understanding and development of adequate solutions.

The second area involves analytical and physical testing of materials and structural assemblies to study performance at the high stress levels experienced during actual earthquakes. It has not been reasonable to study real buildings during actual earthquakes; it is necessary to represent the structure in the laboratory and subject it to forces as nearly equal to real earthquakes loads as is possible, in order to observe the destructive behavior of an earthquake. Our understanding of the structures we design has improved because of the recent National Science Foundation funding of large scale tests. Significant testing has been carried out on reinforced concrete and structural steel assemblies at the University of California at Berkeley, on concrete assemblies at the University of Texas, Univerity of Illinois and the Portland Cement Association.

Testing is expensive, and meaningful data for the engineer must be comprehensive with studies of the many variables so that all of our questions about performance and safety are answered. Shaking tables and large test stands for cyclic testing have produced valuable data to help increase our knowledge of how a building performs during the complex motion experiences in a real earthquake. We are just beginning to see the results of extensive structural testing, and the data is worth the research investment.

After the physical testing of assemblies, analytical methods need to be developed to reproduce the results for future use by the engineering profession in the design of actual buildings. The National Science Foundation has supported the development of computer programs in this area which have been invaluable to the designer. As we learn more from tests and actual earthquake performance, we need to continually update of our methods of analysis. The first generation of computer software is now undergoing revision as part of research supported by NSF, and we are hopeful that the results will provide better methods for the engineer.

As designers of buildings, we still must make assumptions which are elementary and use methods which only partially represent the real seismic behavior of our structures. Much remains to be done to develop economical and realistic methods of analysis which are representative of actual non-linear structural behavior in major earthquakes. This effort is in the early years of development and is truly essential applied research.

The third area where the research effort has been productive is that of applying the collective experience and information to engineering practice in the form of codes. The Structural Engineers Association of California has, for many years, voluntarily developed seismic design criteria and continues to do so. But, the recent explosion of information and the awareness that the seismic design problem is of nationwide interest lead to the NSF funding of a project by the Applied Technology Council (ATC) to develop "Tentative Provisions for the Development of Seismic Regulations for Buildings" (ATC-3). This document, which was published in 1978, represents the collective knowledge and experience of nationwide experts in earthquake engineering and, as such, is the springboard for a future seismic design standard, which can be adopted by jurisdictions throughout the nation.

The ATC-3 document, which is a major achievement, is currently being reviewed by the Building Seismic Safety Commission (BSSC) and will then need to be "tested" by practicing design professionals. This is a current, ongoing effort which will require several years. Nevertheless, immediate results are visible. Discussions have been stimulated in the masonry industry to develop a national seismic masonry design standard. Load factor concepts for all materials are being studied. The gaps in our knowledge, as defined by ATC-3 provisions, are being discussed, covering such subjects as analytic methods, soils effects and building configurations. In addition, the ATC-3 provisions are being reviewed for future adoption in whole or in part by several code writing authorities, in this and other countries, and by corporations with large building programs.

The fourth benefit from the earthquake Hazard Reduction Act of 1977 has been the general dissemination of information. The National Science Foundation has sponsored numerous workshops for specialists working in the earthquake engineering field, where research needs and future directions were discussed. A byproduct of these discussions is the development of concepts and the exchange of ideas. However, this research information and these discussions are of no benefit without publication and education, and there exists a need to translate the research data for use by the design professions and the building industry.

The structural engineering profession in the earthquake environment of California does have several goals, namely:

1. Provide safe structures for the public.
2. Provide economical structures attempting to balance the needs of society with the limited natural resouces to yield cost-effective construction.
3. Development of appropriate seismic guides and codes.
4. Education of the design profession and of the building user.

Structural engineers have a long tradition of volunteer professional effort in the seismic engineering field, and many of our professional accomplishments to date have been achieved without compensation. Our profession has visited damaged areas to observe the effects of major ground motion; we have generated studies and have reviewed research to help in the development of seismic provisions for building codes; and we have participated as advisors to numerous research and policy groups. We look forward to continuing this volunteer effort, but the basic and applied research and education must be funded.

The momentum I referred to earlier must be maintained in the following areas, if we are to improve our structural engineering for earthquake hazard reduction. The following research efforts have high priorities and should be supported by funding:

1. Continuation of the strong-motion instrumentation program with both domestic and foreign sites, as appropriate, to provide the basic data for analytic studies of building earthquake response.
2. Continuation of the engineering testing of steel, concrete, masonry and timber materials and assemblies under cyclic loading and dynamic shaking to increase the understanding of the performance of structures under extreme loading. The results of testing need to be reduced and summarized for use by the practicing design engineer.
3. Continuation of analytical studies to reconcile materials tests and observed behavior in real earthquakes with mathematical models to enable practical design methods to be developed.

4. Continuation of studies to verify the provisions of the ATC-3 document, and then modification of those provisions to reflect the results of the review.

5. Continuation of studies of existing hazardous buildings to develop methods of reinforcing these structures to reduce the hazard they pose to the public.

6. Encouragement of studies of new structural concepts for seismic resistance. Structures which efficiently absorb earthquake energy or which are isolated from the ground shaking have a high potential for yielding economical structural solutions.

7. Promotion of communication and cooperation between architects and engineers involved with design of buildings in seismic areas with the goal of educating the design professions. Special emphasis should be placed on the importance of selecting appropriate building configurations for favorable seismic response, and on the proper design of non-structural components of a building, such as ceilings, partitions, cladding and service systems.

8. Development of an educational program for engineers, architects, building owners, building officials, inspection agencies and contractors to impart the recent knowledge gained from research. Seminars, design guides, visits to post-earthquake damage and non-damage are several important aspects of this needed education.

I can summarize that our goal from this effort is to provide safe buildings for the public and buildings which society can afford. I believe that the Earthquake Hazard Reduction Act of 1977 has been successful and that the work initiated by the program must be continued to reduce the hazard to earthquakes which confronts large areas of this country.

## QUALIFICATIONS OF ERIC ELSESSER

Mr. Elsesser is a consulting structural engineer who is a principal of a design office in San Francisco, California, which has been responsible for the design of many buildings in the San Francisco Bay Area. Currently, he is President of the Structural Engineers Association of Northern California.

He is a member of the American Society of Civil Engineers and serves as Chairman of the Structural Division Seismic Effects Committee. He is also a member of the Earthquake Engineering Research Institute and various other engineering professional societies. He has written technical papers on earthquake engineering and has lectured at universities on general engineering subjects, as well as on earthquake engineering.

Mr. Elsesser has personally examined the effects of major earthquake damage at San Fernando in 1971, and he has participated in the ATC report, "Tentative Provisions for the Development of Seismic Regulations for Buildings."

Mr. **Brown**. Thank you very much, Mr. Elsesser.

We will continue this afternoon—for the entire afternoon—on problems of earthquake research and implementation of the act, and I apologize for the time constraints. There are a number of questions which I would like to discuss with you gentlemen if you can return at 2. I would appreciate it very much.

Mr. **Moore**. Mr. Chairman, I'm very sorry, I am unable to do so.

Mr. **Brown**. We will impose on the other two gentlemen.

Let me ask you one thing. You suggested the importance of—I think you used the term—"research" on some of the institutional aspects on the production of change necessary to achieve our goals in this area. And I think you know that that component is included in the act, but is the most seriously underfunded portion of the research.

May I assume from that that you would lend your encouragement to additional research efforts in this area?

Mr. **Moore**. Yes. Definitely so.

Mr. **Brown**. That's a matter which this committee, I think, is going to give some special emphasis to in connection with the authorition this year.

All right, gentlemen. Thank you very much.

We will be in recess until 2 this afternoon.

[Material referred to follows:]

**BSD BUILDING SYSTEMS DEVELOPMENT INC.**
Architecture/Research 120 Broadway San Francisco, California 94111 (415) 434-3830

Statement addressed to the

House Sub-Committee on Science, Research, & Technology

by

Christopher Arnold, AIA

President, Building Systems Development, Inc.

February 25, 1980

best copy available

**BSD BUILDING SYSTEMS DEVELOPMENT INC.**
Architecture/Research 120 Broadway San Francisco, California 94111 (415) 434-3830

I should like to comment on the role of architectural characteristics, and the architectural profession, in earthquake hazard mitigation.

Until recently research into earthquake hazard mitigation in buildings has been concentrated in two areas: those of structural engineering and engineering geology. The geologists research the nature of ground motion, and the structural engineers research - primarily by computer simulations and physical testing - the behavior of buildings. Curiously enough engineers have long recognized that building configuration - the size and shape of a building, and nature, size and location of its structural components - has a major influence on seismic performance. Since the architect is the design professional that conceives and controls building configuration he is a major participant in seismic design.

The architectural profession has been slow to recognize its important role in seismic design, and has been normally content to leave seismic design to the structural engineer, based on the perception that seismic resistance can be "added" to a preconceived design. Although some engineers have complained about this attitude, many have also turned it to business advantage, and have gained a favorable reputation among architects by letting them design in ways unconstrained by seismic requirements and then demonstrating their ingenuity by making the building safe - or at least making it meet the letter of the building code. Thus the engineer's message to the architect has been unclear and ambivalent: while stressing the importance of the architect's contribution they have simultaneously given the architect little helpful design information to work with, complained because his lack of understanding makes their design job difficult, and yet developed a good business in "fixing up" the architect's design.

In order to provide the architect with systematic information on this topic, and at least to remove one of the impedances to a more rational and economic interaction between the work of the architect and the engineer, our office has for the last two years been researching the problems of building configuration and seismic design. This work has been supported by the National Science Foundation, and will shortly result in a publication addressed to both practicing architects and engineers in an effort to close the information gap between them. As examples of spin-offs from this work major articles are scheduled in the American Institute of Architect's Journal and the Journal of Architectural Education (received by the faculty of all major architectural schools). In addition the State Licensing Board for the State of California is holding discussions with this office with a view to insuring that these issues are represented in the new state licensing examination now under development.

As a result of increasing recognition of the importance of the architect's role in seismic design, the National Science Foundation has introduced line items for architectural studies into its Earthquake Hazards Mitigation Program, and it is to be expected that this area may increase in importance as research expertise develops in architectural schools and in the profession. Because of his integrative approach, the architect is in a good position to research and implement mitigation measures which are now clearly seen as interrelated and interdisciplinary.

There is an urgent yet unfilled need to direct research attention to operational and nonstructural aspects of buildings in earthquakes. The ability of any building to remain operational during and after an earthquake is central to the continued performance of the organizations occupying the building. In essential buildings, such as hospitals, fire and police stations, operational and nonstructural failures can result in life loss even though the building code requirements of structural integrity are met.

In the private sector, operational interruption means loss of critical revenue and associated indirect costs, disruption or displacement which may quickly lead to financial disaster. In the public sector, tax revenue must be used to provide for temporary to long-term relocation of important public services and emergency operations. In such a situation, tax revenue also is used to assist the recovery of private companies.

Since the Alaskan earthquake of 1964, there is growing awareness in the United States that non-structural damage to buildings is a significant factor.

In the 1971 San Fernando earthquake the Orion Avenue Holiday Inn suffered damage requiring $145,000 in repair, or 11% of the original construction cost. Of this amount, $143,000 was non-structural damage and only $2,000 was structural. In the same earthquake, 50 high rise buildings were surveyed. These buildings were 20 miles from the epicenter and experienced little or no structural damage. Of these 43 suffered damage to drywall or plaster partitions, 18 suffered damaged elevators, 15 sustained broken windows, and 8 incurred damage in air conditioning systems. Also in this earthquake, a survey of 25 buildings showed that structural damage was 3% of total damage, electrical and mechanical accounted for 7%, exterior finishes 34%, and interior finishes 56%. This knowledge has resulted in some research, and regulation, concerned mainly with life safety issues, but much more needs to be done.

There are other important aspects of building operations related to earthquakes for which little documentation exists. These include cost and disruption resulting from damage to valuable equipment and supplies and furnishings, and residual costs to organizations from damaged or lost files and records.

The above are areas in which structural behavior, occupant behavior, and behavior of non-structural components, normally designed and specified by the architect, are intimately related. No traditional engineering, social, or geologic research discipline covers these areas. In fact, by his role in building design, the architect is the professional that integrates occupant needs and response, owner needs, structural and non-structural criteria and design. In architectural schools and specialized small businesses such as our own, the research techniques for dealing with these integrated studies are being perfected.

It is, I believe, critical to realize that there is a spectrum of solutions to earthquake hazard mitigation, each with its own costs and benefits. Research to date has tended to concentrate at the high cost end of the spectrum - making more and more buildings conform to increasingly more demanding codes. One result is a public and professional revolt against such methods, as evidenced by the difficulty in obtaining approval for such measures as ordinances that require demolition or the bringing of older buildings up to current code levels. The public prefers to take risks rather than spend large sums of money. Mitigation measures at the low cost end of the spectrum may represent a much more cost beneficial alternative. These are measures such as education, re-programming (moving essential services into safer portions of the building), selective strengthening and alteration, and the investigation of operationally critical non-structural aspects of essential buildings which are structurally sound. All these issues represent important areas of research and implementation that our traditional research disciplines and processes seem largely to have overlooked.

Christopher Arnold
February 25, 1980

## AFTERNOON SESSION

The subcommittee met, pursuant to notice, at 2:15 p.m., in room 2318, Rayburn House Office Building, the Honorable George E. Brown, Jr., chairman of the subcommittee, presiding.

Mr. Brown. The subcommittee will come to order.

I would like to finish up with Dr. Hall and Dr. Elsessor, who have very kindly returned this afternoon from the panel this morning. I regret that Mr. Moore could not return also.

As soon as we complete a few questions of these gentlemen, we will proceed to the related panel on earthquake research issues, which was scheduled for 2.

Dr. Hall, you indicated this morning that you felt that the program set forth originally in the Newmark-Steven Report, the level B, needed to be maintained with adjustments for inflation in order to continue the momentum, I guess you would say, that we have achieved this in the area of engineering. Could you elaborate on that a little bit for us?

Obviously the level of funding has been decreasing from those recommendations over the last year or 2, as I understand it. I would like to know how serious and how severe this is impacting the program, and I would like to have your comments on it.

Dr. Hall. Mr. Chairman, I should be glad to. Perhaps Mr. Elsessor will wish to add a comment.

Both of us listed in our prepared testimony those items which we though were of paramount importance in terms of going ahead with research areas, areas in which there was insufficient information to make some of the decisions we needed to make at the present time for use in our building codes, and in development of special criteria for special projects. It appears to me as a researcher that we could make faster progress if we were funded at a slightly greater level than we have been funded in the immediate past years.

I am not one to say that this type of program should go on forever, as you noted in my testimony, but it is one where I think we can see what we should do. Some of the things both of us listed in our testimony urgently need attention for example the experimental testing of building components and connections, as will as studies of some aspects of the mechanical and electrical equipment field. Studies in these areas are costly and take time.

They are so costly in some cases that I have a feeling this type of work has not been undertaken because the funds are not available. I think it behooves us to move forward with some of these things, and that is what I tried to impart in my testimony.

So the point I was trying to make is that for the immediate future, I think these funds could be spent wisely, well, and expeditiously even with the modest increase mentioned previously.

Mr. Brown. Both of you, I think, have indicated that we have actually accomplished almost a new order of magnitude of understanding about certain aspects of the problem, such as more sophisticated analysis of earth motions and the impact of these motions or the factoring of these motions into the design criteria.

Dr. Hall. That is right.

Mr. Brown. Are we getting enough of this sort of information? I have been told that the last couple of earthquakes in California were probably the most instrumented earthquakes we have had in history. We did have the funds to instrument some of the areas in which we anticipated, because of past history, there might be earthquakes. We really have been able to achieve some exceptionally good information in this area, but that we need to continue with such a program for at least a reasonable time into the future. Is that a fair statement?

Dr. **Hall**. That is a fair statement. Earthquake engineering programs are dependent upon a solid base of information of this type. Some of the people who follow us will get into this area in great depth.

It is very important. Unfortunately in many cases the instruments are deployed and sit there, as you well know, for years. So it is important that the instruments be maintained. This takes money and time.

Mr. **Brown**. Mr. Moore pointed out some facts that I wanted to see if you will confirm, and which I think perhaps need a little bit of emphasis. What we are talking about in this whole area of earthquake engineering is interactions between a rather sizable and technically complex community, that is, the engineering community. We also have a sizable and diverse political or bureaucratic community, that is, the community involved with developing and enacting and enforcing of codes, and then of course, an even broader public which is concerned about the impacts of earthquakes.

We can include here the insurance community and a lot of others of this sort. It is sometimes difficult to get this total package moving along the same route or obstacles, due to institutional problems. He indicated the need to focus a little bit more on this type of problem, which I gather is sort of the mandate of the Building Seismic Safety Council which he serves as chairman of.

Now, it seems that this is the area which has not been getting the emphasis that it should in research funding through the present National Science Foundation program. I want to know if my perception is correct and if we can benefit with having a little more aggressive posture with regard to the solution of problems in this area.

Can I get each of you to react in this area?

Dr. **Hall**. Let me make a brief comment, and then let Eric go ahead.

I could not agree more. I think it is terribly important that we have the follow through to do things in the areas you note such as having buildings designed properly, looking at hazardous buildings and taking steps of the type noted. It seems as though these things occur slowly.

Let me speak to Illinois and the Central United States, which is not as active seismically as California, but finally in the State of Illinois, which we were just discussing down here before another committee, the Capital Development Board, which is responsible for designing, funding and planning buildings with State funds, has adopted a seismic code in Illinois, of all places. This is a first step forward.

It is one thing to have a code on the books, and another to enforce it. That is the next step down the line.

Mr. **Elsessor**. I think we have to precede our dissemination with the research and the studies and the standards and so forth. I think we have now reached the point after the initial phase where the funding for information dissemination should be increased because now I think we have something to talk about.

There is a definite need, as I have said in my testimony, to both impart knowledge to design professionals as to the content of the research, and also to impart that knowledge then to the entire building industry.

Mr. Brown. We sometimes get into controversy around here about funding programs which fall within the general area of, you might say, social science research, which is basically how human systems interact, and how you can achieve desirable change in social organization.

And frequently it is necessary to have a critical physical problem before you can make any progress in terms of the institutional kinds of things. Unfortunately it is also difficult to couple these two sometimes, which is one of the values, it has seemed to us, of the earthquate program. It couples some very important, fundamental areas of physical science and of research with the impact of this reasearch on human activities and how to best accommodate the human activities problem.

From that standpoint, it is sort of an experiment in itself of how we use knowledge to improve the human conditon across an interdisciplinary range of situations. I do not expect you gentlemen to sympathize with that, but it is a problem that faces us here.

Dr. Hall. I can sympathize, but I do not know how to solve it.

Mr. Brown. I think also both of you have commented on the need for and the cost of some of these rather expensive scientific research programs that are aimed at actually observing the results of earthquake motion, seismic motions. This committee recently had an opportunity to visit the National Bureau of Standards where they have some facilities for replicating various dynamic loads on building structures. I think one we saw was a masonry wall that had been subjected to considerable strain.

You have indicated that we need to understand better the effects on the building components, like the electrical, mechanical, and other systems, and so forth. Am I correct in understanding that the National Bureau of Standards is doing a good part of the research in this area, or are there other places where similar research of this type and quality is being done?

Dr. Hall. They are doing some of the research. What they are doing is fine, but there are universities throughout the country, Berkeley and Illinois—many, many other universities have large testing facilities for doing such work. We are doing some of this, but my point is we are not doing enough of this type of work. There are many universities and laboratories involved. It is not just the National Bureau of Standards. I would certainly say they are one.

Mr. Elsessor. If I may add, the National Science Foundation has funded research facilities at the University of California and some facilities at the University of Texas. These are very sophisticated facilities, and it has taken years to develop these facilities with input not only from the university faculties, but from the design professionals who have cooperated in advisory roles.

Dr. Hall. The National Bureau of Standards, of course, has over the years developed a comprehensive relationship with some of the code bodies, and this is important. This is a little different from what you were asking actually.

Mr. Brown. There is one other area I would like to touch on. We have been dealing here largely with problems in engineering design focused on new structures, although I think perhaps both of you have touched on the other part of the problem which is existing structures.

Could you give me just a clue as to the importance of research in trying to alleviate some of the earthquake problems in connection with existing structures? What can we do in this area?

Mr. **Elsessor.** I can give you a specific situation. The city of San Francisco right now this week is, I believe, passing legislation to create an advisory group to study the problem of 4,200 unreinforced masonry buildings that exist in the city. And these are not low-use buildings. They are residential buildings and businesses and so forth. These buildings present a real hazard.

The modification of these buildings at this point would create social and economic problems, as you certainly can imagine. That is one of the pressing problems; how to deal with all three issues? That is, I think we can handle it from an engineering standpoint, but the disruption and the economic burden are much harder to deal with.

I think a study of methods and how to deal with those latter points is certainly essential at this time.

Mr. **Brown.** As I recall, we have had in past years witnesses from the city of Los Angeles who testified on this same point as to the impact in the city of Los Angeles, where I assume they have even more structures that would require modification; and their main concern is the economic problems involved and the most feasible way of addressing this problem.

I do not know that we have any good solutions to it.

Mr. **Elsessor.** To my knowledge, we do not yet, and I think it is an urgent problem.

Mr. **Brown.** Thank you very much, gentlemen. I am grateful to you for returning, and I apologize for the fact that we did not get around to you this morning and had to ask you to come back.

Dr. **Hall.** It is our pleasure.

Mr. **Brown.** Our next witnesses are a panel of four individuals: Dr. Clarence Allen, who is chairman of the National Earthquake Prediction Council; Dr. Paul Pomeroy from Columbia University; Dr. Howard Kunreuther from the Wharton School at the University of Pennsylvania; and Professor Alan Wyner from the Political Science Department of the University of California in Santa Barbara.

Gentlemen, we appreciate your being here very much. We have been dealing primarily in the last panel or the previous panel with what you would call the engineering impact of the earthquake problem, and you are going to deal with another set of problems not primarily, I guess, the structural engineering, but other aspects of the research problem in this field.

We are looking forward to your testimony. Do you want to start, Dr. Allen?

## STATEMENT OF DR. CLARENCE ALLEN, NATIONAL EARTHQUAKE PREDICTION COUNCIL

Dr. **Allen.** Mr. Chairman, I apologize to you for not submitting written testimony ahead of time, but as you may know, we had a magnitude 5 earthquake on Monday morning in southern California that shook everybody up and has pretty well had us running ever since.

Incidentally, had that earthquake occurred closer to the coast in the heavily populated hills of the Los Angeles region, it might well have been a major disaster in terms of land sliding triggered by the earthquake and its effects upon the water-laden soils.

It is also rather ironic that the U.S. Geological Survey, with its tremendous capability and talent for field investigation, was essentially prevented from doing anything because of travel restrictions.

Mr. BROWN. Is that a plug for a little more travel money in the budget?

Dr. ALLEN. It is certainly a plug to let these people be able to exercise the talents and capabilities they have.

I should start off by emphasizing that, unlike some of the other natural hazards, the earthquake problem—at least in my opinion—is a perfectly solvable one. That is, I think we can solve it by better engineering, better land-use planning, and at least eventually, by earthquake prediction. I do not think there is any question but, in the long run, we can reduce the earthquake risk to an acceptably low level, although that is certainly not the case right now.

The Earthquake Hazards Reduction Act of 1977 represents, in my opinion, a major and successful contribution to this objective. I am perhaps somewhat prejudiced since I was one of those who participated in its development and implementation, and all of us sometimes wish that in our own fields we could have perhaps a larger share of the pie. But all in all, my impression is that it is a well-balanced program.

Now, you asked me to comment on the major problems facing researchers in both the fundamental and prediction research areas, and aside from the ever-present problems of funding and redtape, let me mention several areas that I think are particularly significant.

First and foremost, how can we determine where earthquakes are most likely to occur, how big they will be, and how often they will occur? This is not the prediction of specific events, but instead the overall hazard evaluation. These questions are, of course, those that have plagued the nuclear power industry and the dam building industry; I do not have to mention the situation at Diablo Canyon where, had we had more wisdom early in the game, we perhaps could have avoided wasting several hundred millions of dollars, or at Auburn Dam on the American River. That situation probably could have been avoided by a more careful early study of the earthquake hazard.

This is a tremendously important area both for geological and seismological research. Literally billions of dollars are at stake, and significant research contributions have already been made during the past few years in the area of hazard evaluation.

Second, an area of research that I think is particularly significant is the nature of strong ground motion. I am sure that others in the engineering group have already spoken to some degree about this problem—the quantitative description of ground shaking for engineering purposes.

This is a problem that has plagued all construction. Even if we can agree how large an earthquake might occur, there is still disagreement as to the amount of ground shaking to be specified. The studies of course involve not only instrumental observations, but also theoretical studies of how waves are generated by an earthquake source and how they are transmitted to the surface.

Third, there is the whole area of earthquake prediction, which is still obviously in a research phase—not only here, but also in China, Russia, Japan, and everywhere else. Nobody has an earthquake prediction program at the moment that they would claim to be successful, and we all are in the research phase.

I think it is only fair to say that progress over the past 3 years has been a bit slower than we had hoped it might be, although I think most scientists are still optimistic that that objective will be reached; that is, that we will be able some day consistently to predict a large number of earthquakes with a relatively high degree of confidence. And certainly some exciting things have turned up over the past 2 or 3 years.

If anything, I would say that we have learned that it is more important that we understand the fundamental nature of earthquakes. In other words, very basic kinds of research are even more important than we thought 3 or 4 years ago.

There is also, of course, a tremendous challenge in trying to get instruments of various types into areas where earthquakes are likely to occur, and to some degree we are taking a gamble in doing that. We have to place our investment in areas where we think earthquakes are most likely to occur. We have had some successes and failures.

I think the cooperative program with the Russians has been successful from our point of view in getting into an area of relatively high seismicity. We are hoping to do the same thing in China, the big advantage being that they have more earthquakes, and there are more opportunities for placing instruments in areas of high seismicity.

The fourth area of promising research is that of reservoir-induced seismicity; that is, earthquakes that are essentially triggered by the filling of large reservoirs. We have a number of examples of this having happened around the world, and in at least two of these instances, large earthquakes were triggered that almost brought down the dams involved.

Consequently, it is of great importance to understand why these events occur in some places and not others. We are not yet in a position to recognize with any competence where this phenomenon is most likely to occur. As a consequence, conservative dam designers are essentially having to design all large dams for magnitude 6.5 earthquakes that could occur right underneath them. Basically what is happening is that we are wasting perhaps billions of dollars around the world building dams for earthquakes that will not occur—simply because we cannot as yet recognize with any confidence in what areas reservoir-induced earthquakes are likely to happen.

This is an area where research can almost certainly pay off, and I personally have been disappointed that the dam-building agencies in this country have not played a larger role in supporting research in this area.

You also asked me to comment on the concerns of scientists in issuing "messy" predictions. This is perhaps an unfortunate term that I may live to regret, but I guess I was the one who coined it.

What I am specifically referring to is the predictions that do not come up to the ideal that we would like to think of: a generalized warning issued perhaps 5 years ahead of time that becomes more and more specific as to time and place as the day of the earthquake approaches.

Instead, what I think we are likely to see over the next few years are quasi-predictions of a very generalized and uncertain nature that will be much more difficult for society to respond to—for example, a low-confidence prediction throughout the prediction period. That is, a scientist may say there is a 30 percent chance of an earthquake occurring within a certain time period within a certain area, which means, of course, that it probably will not happen.

How does society go about reacting to a prediction of an earthquake that probably will not happen, or a prediction which is very generalized in space and time. For example, there might be a valid prediction, but one that says that somewhere in California we will have a magnitude 7 earthquake within the next year? It is so generalized that it would be hard to respond to, but I think realistically this sort of thing could happen.

Or there could be a prediction in which there was a major disagreement among the scientists. Or we are now seeing another type of phenomenon where scientists are expressing "heightened concern" or a certain sense of "uneasiness." How does society respond to these kinds of expressions, when they do not actually involve specific predictions?

Now, obviously any prediction by a responsible person or a responsible group has a potential for creating tremendous public concern and potentially very serious consequences. We obviously must be very, very careful as scientists in what we do and what we say. Believe me, we agonize over this every time a reporter calls; exactly how do we express ourselves in a way that is honest and forthright and yet not inflammatory.

The public sometimes thinks we are hiding things that we really know about earthquakes but which we are not telling them, because we fear the consequences of telling the truth. I think it behooves us as scientists to try to be as open and honest as we can be, particularly in dealing with the news media, which is our main line of communication with the public.

Even if we wanted to keep a secret, we could not for 5 minutes. I do not know about the Government, but certainly a university could not keep a secret for that long.

It is also clear, I think, that Government agencies increasingly will be dependent upon the collective judgment of scientists about the validity of a prediction that has been offered. This is, of course, the reason why the National Earthquake Prediction Evaluation Council has been set up. It essentially follows the lead of the California Earthquake Prediction Evaluation Council, which allows the Governor to at least have the judgment of a group of qualified scientists as to the validity of a prediction coming from any source whatsoever.

In the field of prediction, my feeling is that these next few years are going to be rough ones for us. As we gradually improve and increase our prediction capability, we are going to have some difficult times. Along with probable successes in predictions, we are almost certainly going to have some failures and false alarms, of which we cannot have too many and still maintain public support for the program.

We will be feeling our way very, very carefully in this area, and I think that we as scientists are going to have to get together and try to determine what is the best way of making our research results known in a way that will have the best effect on society.

With all the public interest in prediction, I hope I do not have to remind you that earthquake prediction is only a part of the total national earthquake hazards reduction program and not necessarily the most important part. Certainly the total program is a balanced one in which earthquake prediction is merely one element. I think the total program is one we can be proud of, and I hope that the momentum we have now gained can be continued.

Thank you.

Mr. **Brown**. Thank you very much, Dr. Allen.

Dr. Allen, it seems to me, just as a layperson who does not keep in too close of a touch with this area but who is very much interested, that we have here a situation which is very common to science. We develop a body of knowledge and a theoretical framework, and we seem to make predictions of physical phenomena, whatever they may be; deviation of light through the Sun's gravitation, for example, is a classic example, and if you could make an accurate prediction as to that you could prove the theory of relativity.

We can expect, I would assume, because of the complex nature of the subject matter here that it probably will become increasingly sophisticated, but probably never perfect. Is that a reasonable way to look at it?

Dr. **Allen**. I think that is true. People often ask me when will we predict earthquakes, and of course, the answer is that we have already predicted earthquakes, and some of them have been very successful. The more important question is: When will we predict earthquakes with a high enough consistency rate to be of use to anyone?

It is a little like the cancer problem, and people ask when are we going to conquer cancer. Clearly it will not happen on any given day, and we will probably never be completely successful.

The big problem with earthquake prediction, as compared to some other kinds of scientific endeavors, is that as we develop this prediction capability, we may be stumbling along the road in terms of false alarms and failures which have a direct effect upon the public, unlike many other scientific developments. And I think, in that sense, we have to plan our way somewhat more carefully than for a more typical scientific research endeavor.

Mr. **Brown**. I want to explore this a little bit. Obviously because of the significance of the public impact of the events being predicted, we have to be concerned about public reaction and all the other factors involved here. Of course, this leads to the assumption that the program has to include a public education component, that is, hopefully a more sophisticated public will understand the probability aspects of this thing and will react more rationally if they are informed and reasonably sophisticated.

So the overall national hazard reduction program should include some component dealing with the problem of developing the proper kind of public reaction and how to handle it. This is included in the California program, if I understand it. There is some concern for the psychological and political consequences of the prediction process, or am I mistaken?

Dr. **Allen**. I fully agree with you, and one of my colleagues stated some time ago that it would be a tragedy if we learned how to predict earthquakes before we learned what to do with predictions when they arrived.

I fully agree with that view, and I have supported this aspect of the program. I have even supported some increased funding in the area of social response to earthquake prediction. This is an area of great interest right now.

We have meeting after meeting with disaster preparedness people specifically to look into the problem of how should a city go about preparing for that day when earthquake predictions are coming down the pike. And particularly, how does it go about preparing for these "messy" predictions that will be much more difficult to respond to?

Mr. **Brown.** I seem to recall that chamber of commerce has expressed a concern about what predictions are going to do about land values, et cetera.

Dr. **Allen.** It is obviously a great concern. In the one quasi-prediction with which I was associated at Caltech, a city councilman of Los Angeles threatened to sue Caltech for lowering property values in the San Fernando Valley. That is the kind of thing that causes us to lie awake nights a bit wondering what our best approach is.

Mr. **Brown.** To take this a little bit further, it seems to me that, recognizing there are certain major differences, but we still have a parallel here with the situation that exists as we try to engage in reasonably sophisticated weather prediction and particularly major storm predictions and warnings.

There are obvious differences, but again, we have a professional cadre who understands the physical phenomenon and who are trying to determine what is going to happen tomorrow or 3 days from now or a month from now; and whatever happens is going to have an impact on society.

Can we learn anything from the history of the development of our knowledge of meteorology and our ability to predict both short- and long-range weather phenomena?

Dr. **Allen.** I can only say that this was recognized by Director of the Geological Survey when one of the members he appointed to the National Earthquake Prediction Evaluation Council was the Director of the National Hurricane Center. So yes, clearly we are trying to learn from their experience.

There are major differences, of course, in hurricane warnings and earthquake predictions. I think also that we have much to learn from experiences of other countries. Chinese society, for example, is very different from our society, but it is clear that we have a great deal to learn from the Chinese in their efforts at earthquake prediction. They have had some successful prediction, and many, many failures and many, many false alarms.

Mr. **Brown.** Do you feel that there is an adequate exchange of information between us and the Chinese specifically, and between our research community and the broader international research community?

Dr. **Allen.** This particular area of seismology is one in which communication is really pretty good. I have been, frankly, surprised in China to find out how aware the Chinese were of our literature and even the Russian literature. We are rapidly developing ties with the Chinese scientists. And we have had close ties, at least in the past, with the Russian scientists.

Of all the scientific areas I am aware of, it seems to me this is one in which we have had excellent communication and personal interaction.

Mr. **Brown**. Is there any kind of a real time information sharing network? I do not mean just scientific visits periodically but interconnected research centers to allow American seismologists to be aware of an imminent event in China and to follow the development as it progresses.

Dr. **Allen**. I am not aware of any formal development of that sort yet.

Mr. **Brown**. We have this in weather obviously.

Dr. **Allen**. And in the tsunami warning service, but I am not aware as yet of any formal avenue for routine exchange of information.

Mr. **Brown**. One of the subject matter areas before the subcommittee—it does not deal specifically with earthquakes—it is the whole question of rationalizing the communication of scientific and technological information. I raised the question because of the relevance of this to our general interest in this subject matter.

For example, I think Harrison Brown is trying to develop a scheme to link certain research facilities he is working with in the energy field around the Pacific Basin. I wonder if a case can be made for the desirability of doing this on a broader basis, a more generalized basis. I am looking for sectors in which this might make a contribution to the progress of science to see how much emphasis there might be behind utilizing, say, a satellite network or something of that sort.

I will not ask you to comment unless you are strongly moved.

Dr. **Allen**. I will just say that the area of earthquakes certainly represents an area of mutual interest between us and many people, and we have a great deal to learn from one another and in working in different environments. An honest case can be made for earthquake studies that is somewhat harder to make in other sciences.

If any area is ripe, I think seismology is one of those.

Mr. **Brown**. If we are going to go into a substantial effort at global earthquake prediction, I think you can begin to make a case for trying to link a lot of centers or nodes together in an effort to improve this process. And of course, there are other related aspects of it, such as making available specialized data banks and so forth that might be useful on a global basis.

Gentlemen, I have a serious problem here right now in that that series of bells indicates there is a vote, probably several votes, that are going to occur simultaneously, ad naueum, as we say—no, that is not the word.

I think in order to keep my record above the passing average, which is about 70 percent around here, that I had better declare a short recess. I apologize very much for the necessity of doing that, but I will try to make it up to you with a free cup of coffee or something if you would allow me to do that.

The subcommittee will be in recess briefly.

[Whereupon, a recess was taken from 3:03 p.m. to 4:45 p.m.]

Mr. **Brown**. The subcommittee will come to order.

If I thought it would do any good, I would apologize. Unfortunately there is no way we can control the operation of this machine around here.

Why don't we go ahead with Dr. Pomeroy.

[The biographical sketch of Dr. Pomeroy follows:]

**CURRICULUM VITAE** **PAUL W. POMEROY**

Birthdate:

August 14, 1931 in Portland, Maine

Education:

Ph.D., Geophysics, Columbia University, 1963, with major in Seismology

B.S., Geophysics, Massachusetts Institute of Technology, 1953

Graduate Deering High School, Portland, Maine, 1949

Professional Experience:

Rondout Associates, Incorporated, Stone Ridge, New York
President - July 1976 - present

Lamont-Doherty Geological Observatory of Columbia University
Senior Research Associate - July 1974 to present

New York State Geological Survey, Albany, New York
Associate Scientist - Seismology - April 1973 to July 1976

State University of New York - Albany
Adjunct Full Professor - August 1974 to August 1976

Department of Geology and Mineralogy, University of Michigan
Professor of Geophysics and Director of Seismological Observatory
1968 to 1972

Lamont-Doherty Geological Observatory of Columbia University

| | |
|---|---|
| Senior Research Associate | 1965 - 1968 |
| Research Associate | 1963 - 1965 |
| Graduate Research Associate | 1956 - 1963 |
| Research Assistant | 1953 - 1954 |

Military Service:

U.S. Air Force, AFCRL, Research and Development Office, 1954 - 1956

Research Areas of Interest:

Studies of acoustic wave propagation in atmosphere; use of seismic methods to measure sea thickness and bearing strength; use of elastic waves to determine properties of glacial ice; use of mechanical filters in electromagnetic seismographs to improve response characteristics; studies of elastic wave propagation from large, high-altitude, near-surface and underground nuclear explosions; studies of seismic waves using analog and digital analysis techniques; the establishment of world-wide seismograph network using magnetic tape recording; studies of source mechanisms for underground explosions and small magnitude earthquakes.

Current research includes development of high-gain, long-period wide-band instrumentation; studies of spectra of small magnitude earthquakes and explosions, studies of relative excitation of body and surface waves by explosions and earthquakes; studies of body wave and surface wave propagation in Africa; studies of aftershocks from shallow events in Africa; studies of acoustic background particularly associated with rock bursts and volcanic activity; evaluation of seismic hazard in New York State.

Membership in Professional and Honorary Societies:

Geological Society of America
American Geophysical Union
Seismological Society of America
American Association for Advancement of Science
American Geological Institute
Institute Electrical and Electronic Engineers - Senior Member
Eastern Section, Seismological Society of America - Chairman 1979 - date

Dr. Pomeroy is co-ordinator of the Northeast United States Seismic Network, a position he has held since the inception of the network in 1975.

## STATEMENT OF DR. PAUL W. POMEROY, COLUMBIA UNIVERSITY

Dr. Pomeroy. Mr. Chairman, I would like to thank the subcommittee for the opportunity to discuss the research portion of the Earthquake Hazards Reduction Program.

With some trepidation in the presence of so many Californians, my discussion today deals with the research on earthquake hazards and risks in the eastern and central portion of the United States.

Mr. Brown. That is a valuable adjunct to the major part of the States. [Laughter.]

Dr. Pomeroy. Although as we all know, large earthquakes occur more frequently in the western part of the United States, particularly California, large and devastating earthquakes have occurred in the eastern and central portions of the United States, and the one thing we can state with certainty is that they will occur again.

In the Western United States, the theory of plate tectonics provides a unifying set of concepts for the study of earthquake occurrence, hazard analyses and prediction. In the east and central portion of the country, an intraplate region, the causative mechanisms of intraplate earthquakes are not well understood.

A comprehensive research effort to enhance the understanding of the phenomena has been established under the earthquake hazards reduction program and, in cooperation with complementary programs in other agencies, has already yielded some insights into the complex occurrence of the large intraplate earthquakes.

There are four points I would like to emphasize today, and I will try to keep them brief. These involves the current level of our understanding of earthquake occurrence in the Eastern United States; second, regional or local differences in the level of our understanding regarding the occurrence of earthquakes in the East; third, a question which the subcommittee is specifically asking us to address, the differences in research needs in the East as contrasted with the West; and fourth, I would like to mention the clear but undefined nature of the risk in the Eastern United States.

So, starting with current insights into the occurrence of Eastern U.S. seismicity, both Dr. Menard and I in our written testimony have cited the Missouri experience as an example of the improved understanding of the occurrence of seismic activity obtained under this and related programs. Milestones in that study included first a synthesis of existing geologic and geophysical data; second, major geological and geophysical data-gathering programs; third, interpretation of geophysical maps which indicated the presence of an ancient rift structure with associated intrusive bodies in the area. And that led, in turn, to several suggestions regarding the association of earthquakes with intrusive bodies.

Another milestone, the installation and operation of a significant seismic network in that area, which over the course of the years has allowed the description and delineation of a very linear belt of seismicity within the rift zone, and finally the reflect profiling which was carried out very recently, which delineated a very active major fault system coincident with the linear belt of seismicity which is presumed to be the site of the major 1811–12 earthquakes in that area.

The concentrated research effort in this area has brought together the funding and the personnel required to synthesize the data and to gather the appropriate new data on structural geology, seismicity and geophysics. Much work remains to be done in the New Madrid area to delineate the full extent of the fault zone, et cetera.

Beyond that, and even more importantly, further studies are going to be needed to determine whether, at this point, the model is applicable to the occurrence of earthquakes elsewhere; for example, in the Wabash Valley directly to the north of the New Madrid area.

My second point deals with regional differences within the East and our level of understanding of earthquake occurrence. And, here, it is constructive to compare the New Madrid area and the Northeast portion of the country. We have recently achieved a synthesis of some of the available geological data in the Northeast part of the country. A similar synthesis of geophysical data for that entire region is currently not available.

In the Northeast, we have established a major network of over 100 seismic stations to delineate where micro earthquakes occur. The reason for that is simply to gather data in a shorter time frame than we can by waiting for the larger events to occur.

We can identify diffuse zones of activity in the data resulting from 10 years of network operation in this area, but linear belts of activity similar to that observed in the New Madrid area are certainly not clear.

Some earthquake activity in some areas like New York State can be associated with fault zones. But in New England, ancient faulting is essentially ubiquitous and associations of earthquakes with specific geologic structures is at best not straightforward and at worst probably not possible in the immediate future.

It is interesting that the distribution of micro earthquake activity, as delineated by the seismic network, is in its gross appearance very similar to the appearance and distribution of major earthquakes over a 400 year time frame. And, in my written testimony, there are some comparative maps where that can be observed.

At the same time, there are individual differences in the distribution of the smaller earthquakes relative to the larger historical events which preclude the direct use of the small-scale activity as an input to hazard analysis. Since the sources or causative mechanisms remain enigmatic, there have been numerous hypotheses put forward in an attempt to explain this activity. Some of those hypotheses are also listed in my written testimony.

Evaluation of those hypotheses is extremely important, and we have a program now where that evaluation is being carried on, but some of the evaluations themselves require major research activities, and we simply do not have the necessary resources to carry those things forward in a fast time frame. They will be done, I am sure.

Progress in our understanding earthquakes in the northeast has been significant, but we have a long way to go before we can even say that we know what the causatives geologic structure is.

My third point deals with differences in research needs between the Eastern and Western United States. The basic difference involved is one that Dr. Wesson cited yesterday, basically that it is a matter of differences in the geologic characteristics of the region.

Much of the east and central United States is covered by thick sedimentary layers and other layers which effectively obscure the sources of the earthquakes. There is no instance in the East at the present time where, following the occurrence of an earthquake, one could identify and measure fault movement. That is, we cannot go out and simply look at a fault and say this fault moved six centimeters in such-and-such a direction. We cannot do that.

Thus, in looking for a causitive structure, we are essentially confined to geophysical investigations, such as aeromagnetic mapping and deep crustal seismic profiles such as cocorp. These are, as you know, very expensive. Other tools, such as the determination of the stress fields by hydrofracturing techniques over large geographic regions in the east and central part of the country and operation of seismic networks are going to require—to achieve the same level of understanding that we have in California—a much longer time frame.

Timing also enters into the picture because in some areas the base line data simply is not yet available to the point where we can apply with certainty these more sophisticated procedures.

The fourth and last point I will just touch on. Because recurrence rates are low in the eastern United States, it really is not possible to accurately evaluate the recurrence rates of these large earthquakes. If you only have one earthquake over a 400 year time period, it is difficult to tell how often it will recur.

I am very concerned about the Eastern United States because of the Charleston, S.C. earthquake. I think all seismologists have a rather intuitive feeling that the Charleston earthquake is located in Charleston because of a unique set of geologic conditions, and we hope that that intuition is correct.

However, we do not have a data base which would support such a conclusion, and, lacking such a data base, with potential for a Charleston, S.C. type earthquake in other parts of the country along the eastern seaboard, I believe that our risk evaluation should go forward very rapidly.

The Nuclear Regulatory Commission has been supporting a major research activity in the Charleston area for a number of years and perhaps at the same level even as that in the New Madrid area. But the results have not—although they have yielded a vast amount of scientific information—have really not made a critical leap in our understanding, which I think we have in the New Madrid area.

I was asked to say a few words about possible improvements in the program, and I guess I would only say that fine tuning in any program is certainly always possible, but, in total, I really have very few suggestions. I would like to offer the reason for that.

Throughout the program since its inception, scientists outside the agencies have really had strong inputs into the program operations, both through advisory committees and through the normal proposal review channels. Program managers in the operating agencies have been always accessible and both attentive and responsive to suggestions and criticisms from the outside.

I believe those outside inputs are probably a significant reason why the program has been such a success.

[The prepared statement of Dr. Paul W. Pomeroy is as follows:]

# Testimony
# of
# Dr. Paul W. Pomeroy

in regard to
the Earthquake Hazard Reduction Act of 1977

before
Sub-Committee on Science, Research and Technology
Committee on Science and Technology
U.S. House of Representatives

28 February 1980

## PURPOSE

This testimony deals with the research on earthquake hazards and risk in the eastern and central portions of the United States. Although large earthquakes occur more frequently in the western United States, particularly in California, large (including perhaps the largest earthquakes in the U.S. in recorded history) and devastating earthquakes have occurred in the eastern and central portions and will occur again. In the western United States, the theory of plate tectonics provides a unifying set of concepts for the study of earthquake occurrence, hazard analyses and prediction. In the east and central portion of the country, an intra-plate region, the causative mechanisms of intraplate earthquakes are not well understood. A comprehensive research effort to enhance the understanding of the phenomena has been established under the earthquake hazards reduction program and, in cooperation with complementary programs in other agencies, has already yielded some insights into the complex occurrence of the large intraplate earthquakes. Those insights together with future needs will be discussed here.

## BACKGROUND

The overall goal of the National Earthquake Hazards Reduction Program - derived from the Earthquake Hazards Reduction Act of 1977 - is to reduce the risks of life and property from future earthquakes in the United States. The overall objectives of the earthquake hazards reduction program, as defined by the Act, include -

1. the development of technologically and economically feasible earthquake resistant construction;
2. the implementation of an earthquake prediction system in high seismic risk areas;
3. the development of building and land use codes for earthquake prone areas;
4. the assessment and development of improved understanding of earthquake related issues as they pertain to controlling the risk from earthquakes, planning to prevent the risks and planning the societal response to earthquake occurrences;
5. the education of the public;
6. the development of research on the use of existing information to mitigate hazards, on the social economic legal and political consequences of earthquake prediction and on the ways to insure the availability of earthquake insurance;

and 7. the development of research, basic and applied, leading to a better understanding of the control and attenuation of seismic phenomena.

The research elements of the program include -

1. research into the basic causes and mechanisms of earthquakes;
2. development of methods to predict the time, place and magnitude of future earthquakes;
3. development of an understanding of the circumstances in which earthquakes might be artificially induced by the injection of fluids in deep wells, by the impoundment of reservoirs, or by other means;
4. evaluation of methods that may lead to the development of a capability to modify or control earthquakes in certain regions;
5. development of information and quidelines for zoning land in light of seismic risk in all parts of the United States and preparation of seismic risk analyses useful for emergency planning and community preparedness;

6. development of techniques for the delineation and evaluation of the political effects of earthquakes, and their application on a regional basis;
7. development of methods for planning, design, construction, rehabilitation, and utilization of manmade works so as to effectively resist the hazards imposed by earthquakes;
8. exploration of possible social and economic adjustments that could be made to reduce earthquake vulnerability and to exploit effectively existing and developing earthquake mitigation techiques;

and 9. studies of foreign experience with all aspects of earthquakes.

This testimony deals with those portions of the research program having applicability to the eastern and central United States.

## RESEARCH AREAS

The causative mechanisms of intraplate earthquakes occurring in the eastern and central United States are not well understood. These mechanisms must be understood in order to have a capability for prediction. Numerous seismotectonic hypotheses have been put forth to explain intraplate seismicity and most of these are tabulated in Table I. These hypotheses must be evaluated and that evaluation is currently underway under the sponsorship of this program and complementary programs of other agencies which are closely coordinated with the research activities of the earthquake hazards reduction program.

These evaluations involve major research efforts and include the following elements -

1. synthesis of existing data on a national, regional and local basis;
2. gathering of new data in areas of greatest seismic risk and in areas of greatest potential for achieving understanding;
3. testing hypotheses against the data;
4. evaluating the hypotheses throughout the whole region of interest;
5. selection of the most promising hypotheses.

Following the selection from the existing hypotheses (or new ones that evolve in the course of the research), the most promising hypotheses can be utilized to delineate and evaluate earthquake hazards and risk in the eastern and central portions of the U.S. This is, of necessity, a slow and evolutionary process. Significant progress has already been made and, with the continuing support of this program, further insight into this problem and its solution will be forthcoming. While these investigations continue, interim evaluations of risk can and are being made based on current seismic data and evaluations of earthquake hazards can and are being carried out.

In the following section, a brief discussion of accomplishments in two geographical areas in the eastern and central U.S. and at the national level will be presented.

## TABLE 1

### Hypotheses

Zones of Weakness: Faulting and Fractures.

H-1. Aulacogens - paleo-rift zones, failed rifting arms

H-2. Mesozoic age faulting - remnant structures for Atlantic rifting

H-3. Intersection of oceanic fracture zones and continental crust

H-4. Compressional, brittle ocean-closing structures with orientations favorable for deformation under present day stress field

H-5. Zones of fault structures with demonstrable movement - Cenozoic or younger

H-6. Persistent zones of crustal weakness through geologic time - tectonic heredity

H-7. Cratonic block boundaries and basin hinge zones

H-8. Meteorite impact and siatreme stress

Zones of Stress Concentration.

H-9. Stress concentrations at intrusive bodies or sites implied by gravity anomalies

H-10. Stress concentration at basins, domes and arches in midcontinent basement

H-11. Variation in crustal thickness or strength

H-12. Variation in moduli of thermal expansion or contraction

H-13. Variation in composition, structure or thermal characteristics

Other factors.

H-14. Crustal warping or tilting due to presently acting deformation

H-15. Induced seismicity - mining activity, reservoir loading, fluid withdrawal or injection

H-16. Patterns of microseismicity

## ACCOMPLISHMENTS AND NEEDS

### 1. National.

Accomplishments at the national level that affect the eastern and central portions of the country are too numerous to list. In fact, the total research effort will ultimately affect the ability of scientists to delineate and evaluate seismic hazard and risk. Several syntheses of data at the national level are of particular significance, including -

1. a national synthesis of heat flow data
2. a national synthesis of stress measurements
3. a national probabalistic map of peak ground motion acceleration
4. a national map of young faults
5. an average elevation map of the conterminous United States.

A gravity map for the United States is already available, but a clear need for a national magnetic anomaly map is recognized within the community.

### 2. Regional.

Accomplishments at a regional level are highly variable and will be discussed here using two specific areas:

a. The New Madrid, Missouri, area - site of the largest earthquakes in the conterminous United States in 1811 and 1812.

b. The Northeast United States - including New England, New York and Pennsylvania - the site of the following earthquakes

| | |
|---|---|
| Nov. 9, 1927 - Newbury, MA | Intensity VIII |
| Nov. 18, 1755 - East of Cape Ann, MA | Intensity VIII |
| May 18, 1791 - East Haddam, CT | Intensity VIII |
| Aug. 12, 1929 - Attica, N. Y. | Intensity VIII |
| Sept. 4, 1944 - Massena, N.Y. | Intensity VIII |
| Feb. 21, 1954 - Wilkes Barre, PA | Intensity VII |

New Madrid, Missouri (a.)

In the New Madrid area, the level of understanding of the source of the great earthquakes that occurred there has been significantly enhanced by the concentrated studies carried out under the aegis of this program and related complementary programs of other agencies. The rate of occurrence of earthquakes in this area is relatively greater than in other eastern and central United States areas. Significant milestones in this enhanced understanding include:

1. The synthesis of geologic data for the area including geologic structures, geomorphic data and stratigraphic data, have been carried out to investigate and characterize surface deformation.

2. The interpretation of magnetic data indicate a major tectonic event involving the development of a large graben or rift occurred early in geologic time. The data also indicate that much later, thinning of the crust led to the emplacement of mafic plutons and dikes in the rift zone. One hypothesis, tabulated earlier, suggests that local concentrations of stress can occur at the edge of the mafic plutons and result in rock failure or earthquakes.

3. A seismic network of 30 stations has been established in the New Madrid area. Results from this network show a distinct northeast trending linear belt of seismicity with a northwest trending offset. The linear belt of seismicity lies within the ancient rift structure. Fault plane solutions from seismic data show a consistent pattern of motion along the seismic belt and the northwest offset.

4. A detailed seismic reflection profile has shown a basement fault system located within the ancient rift beneath the northeast trending zone defined by the epicenters.

In this area, a concentrated research effort has brought together a number of scientists who have synthesized existing data and then gathered critical data on the structural geology, the seismicity and the geophysics. Although much work remains to be done, the picture of the source of the seismic activity begins to focus on an ancient rift system subjected to later magmatic intrusions with an active buried fault structure as the site of recent seismic activity.

Northeast United States (b.)

In the northeast, our understanding has not yet progressed to the same level as that in the New Madrid, Missouri, area. Important milestones are outlined below -

1. A synthesis of all published geological information has been carried out and a single map, facilitating comparisons between different areas within the region, has been prepared and published.

2. A network of seismograph stations (known as the Northeast United States Seismic Network - NEUSSN) has been established across the area (Fig. 1)

3. A comparison of data from the northeast network for the period Oct. 1975 - March 1979 (Fig. 2), data for the Northeast U.S. and adjacent Canada for the period 1970-1979 (Fig. 3), and the historic seismic data for the period 1534 - 1959 (Fig. 4) indicates remarkable stationarity between the large historic seismicity and recent, mostly micro, seismicity. The seismic activity, although not random throughout the area, is diffuse and may be related to different causal mechanisms.

4. Syntheses of detailed geologic factors and gravity and magnetic data are currently underway and detailed testing of some of the seismotectonic hypotheses proposed for this area has been initiated. The regional gravity and magnetic maps are needed for this evaluation.

5. Close coordination and cooperation with the Canadian government organizations responsible for seismic hazard and risk has been initiated and continues at the present time. As a result, seismograph stations have been established by Canada at key locations to enhance the NEUSSN efforts.

6. Concomitant with the observational programs and the synthesis of currentlys available data, research programs are underway at many academic institutions, the federal and state geological surveys and in the private sector to elucidate various aspects of the regional problem. This work involves detailed geologic investigations, association of geologic structures with seismic activity, stress measurements and geophysical investigations of proposed structures.

A significant beginning has been made in understanding the causative mechanisms in the Northeast. Because of the low rate of occurrence of seismic activity, the observational seismic program must be continued over a long time interval. The ongoing research programs, coupled to the observational program, insure the most efficient allocation of limited resources toward the solution to the problems.

Although two areas have been used as examples of accomplishments and needs, investigations and research have been and hopefully will be carried out in all of the areas in the eastern and central United States that are prone to the occurrence of earthquakes. Greatest emphasis has been placed in the program to date on those areas where the largest, most destructive earthquakes have occurred and, as a consequence, where the risk is known to be present. Other areas, which may be aseismic or may not yet have had a major earthquake, will benefit directly from the regional research currently underway in high risk areas.

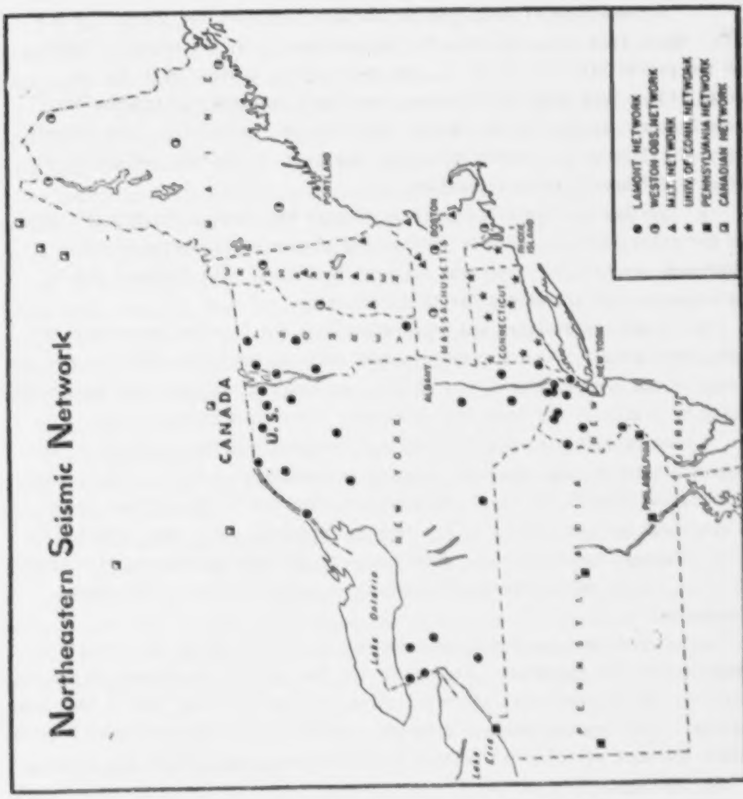
Northeastern Seismic Network
CANADA
U.S.
NEW YORK
PENNSYLVANIA
MASSACHUSETTS
CONNECTICUT
RHODE ISLAND
BOSTON
PORTLAND
ALBANY
NEW YORK
PHILADELPHIA
Lake Ontario
Lake Erie
LAMONT NETWORK
WESTON OBS. NETWORK
M.I.T. NETWORK
UNIV. OF CONN. NETWORK
PENNSYLVANIA NETWORK
CANADIAN NETWORK

Figure 1. Locations of Stations of the Northeast United States Seismic Network.

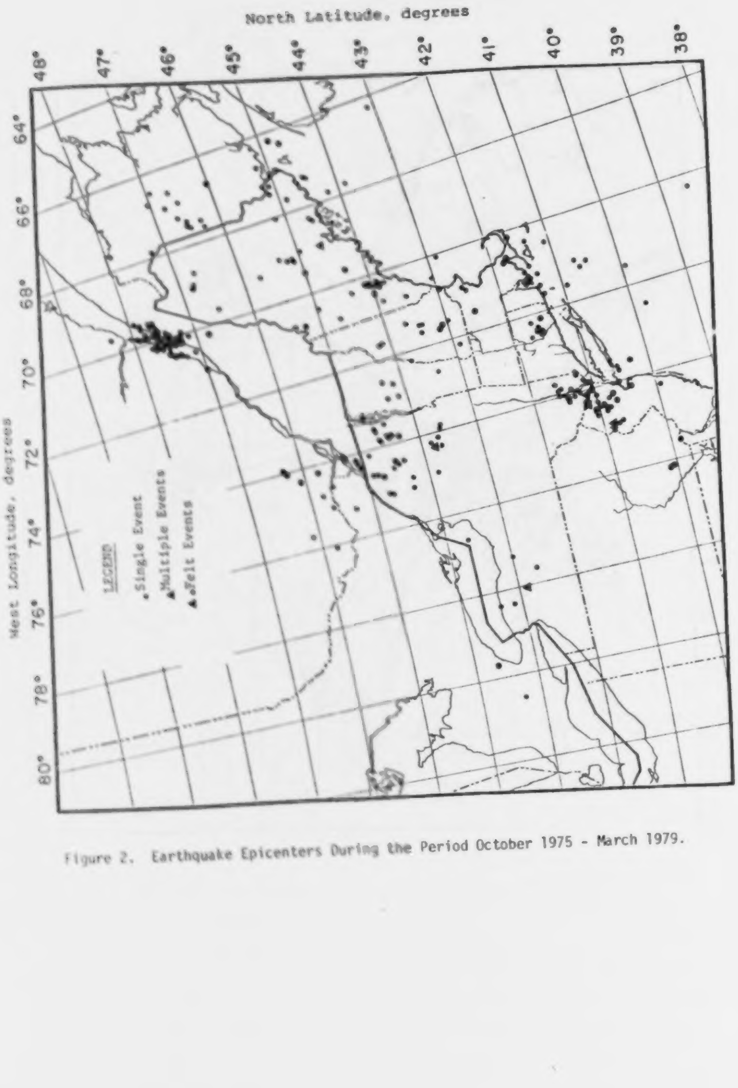
North Latitude, degrees
48°
47°
46°
45°
44°
43°
42°
41°
40°
39°
38°
West Longitude, degrees
64°
66°
68°
70°
72°
74°
76°
78°
80°
LEGEND
Single Event
Multiple Events
Felt Events

Figure 2. Earthquake Epicenters During the Period October 1975 - March 1979.

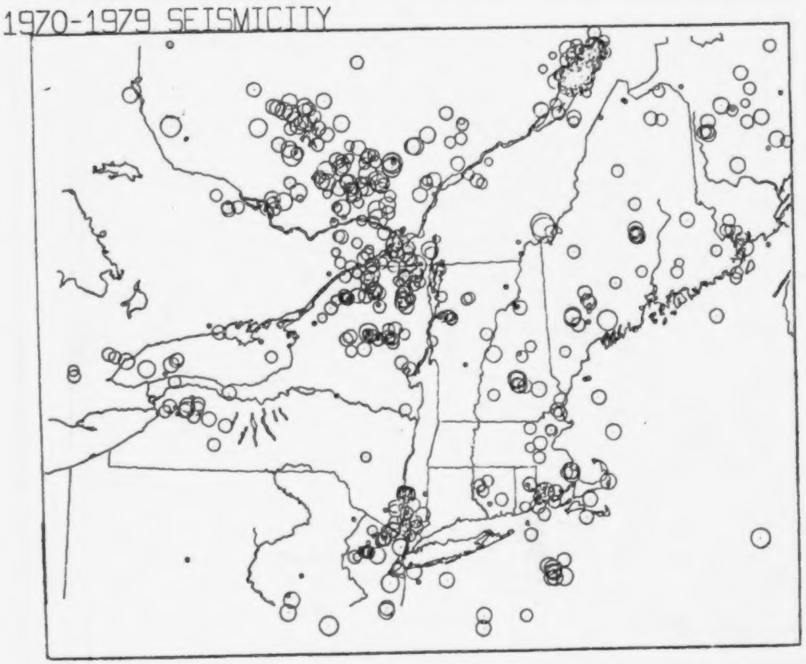
1970-1979 SEISMICITY

Figure 2. Earthquakes in the Northeast United States and Adjacent Areas for the period 1970 - 1979

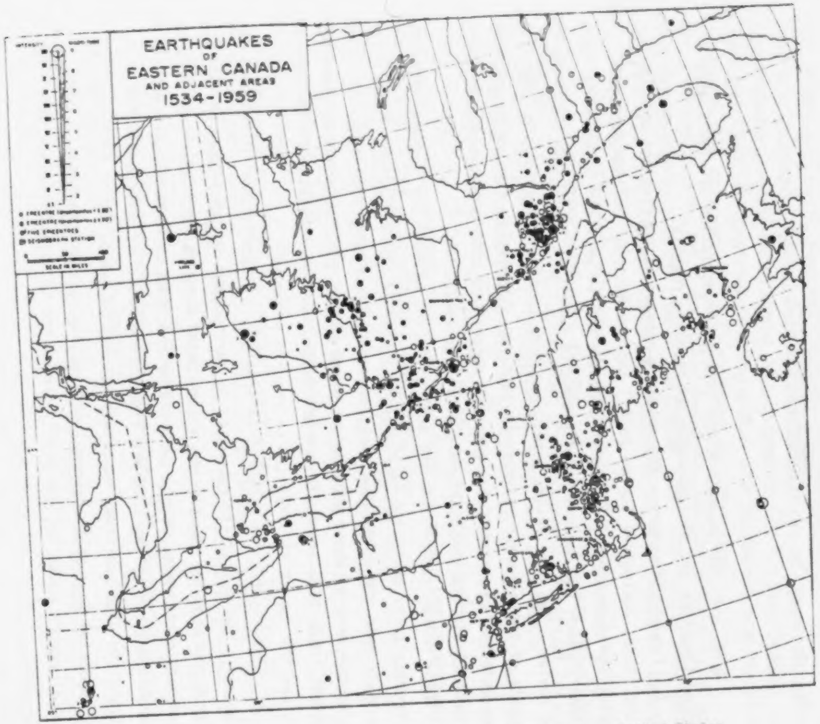
EARTHQUAKES
OF
EASTERN CANADA
AND ADJACENT AREAS
1534-1959
INTENSITY
MAGNITUDE
FIVE EPICENTRES
SEISMOGRAPH STATION
0
50
100
SCALE IN MILES

Figure 4. Historic Earthquake Activity in the Northeastern United States.

## PROGRAM ORGANIZATION

Here, only two aspects of the program organization are dealt with - funding structure and dissemination of research results.

1. Funding Structure - The research program is carried out through the United States Geological Survey (USGS) and the National Science Foundation (NSF). Funding for fundamental studies through the NSF is provided to academic institutions through the mechanisms of proposals submitted to NSF and subjected to peer review. The peer review panels are made up of representatives from all segments of the academic and private sectors. Similarly, funding to organizations external to the USGS for research support of USGS programs is provided by the USGS via the proposal and peer review route.

These mechanisms provide the most efficient methods for funding research. All proposals are evaluated carefully by a broadly representative group of scientists both for scientific excellence and for program applicability. Funding of the best of these proposals insures a high quality return on the dollars invested. Many good proposals are not funded each year because of the lack of funds and the impact of inflation on ongoing programs.

2. Dissemination of Research Information - Dissemination of research information to the scientific community is carried out in two ways. Results of research sponsored by the NSF are disseminated through the usual scientific dissemination channels, namely publication and scientific meetings. Results of research sponsored by the USGS are also disseminated in this manner but, in addition, the USGS publishes routinely volumes of summaries of technical reports submitted to them by external and internal project managers. These technical report summaries are highly useful and their publication should be encouraged.

## CONCLUSIONS

The seismological research activities carried out under the sponsorship of the Earthquake Hazards Reduction Program have already resulted in significant advances in our understanding of the causative mechanisms of intra-plate earthquakes - the type of earthquakes that occur in the eastern and central United States. Insights into the causative mechanisms of these intra-plate events are forthcoming at different rates in different regions. In the high risk New Madrid area, a clear picture is emerging, while in the northeast, additional concentrated work is required. The scientific and social rewards of a continuing program are significant, and important insights can be predicted for the years ahead.

Mr. Brown. Thank you very much, Dr. Pomeroy.

You are generally satisfied with the allocation of research efforts to the various geographical areas of concern in the United States, and do you feel that the eastern problems and the Midwest are receiving a relatively fair proportion of the resources activities?

Dr. Pomeroy. Yes, sir, I do. That looks at the question in an overall sense, including not only these programs that are under discussion here, but also the complementary programs in the Nuclear Regulatory Commission.

Mr. Brown. There is obviously some research that is area-specific that is necessarily focused on a particular area. There are other kinds of research, which do not have that characteristic. It could be done anywhere, I suppose, and it could be appropriate anywhere.

I think we are concerned personally in the Congress that no major area is being neglected. We generally express concern here when it comes to funding of research that there be an adequate geographical distribution, even though there is not always a basis for geographical distribution. That is a political consideration.

If I recall correctly, some of the fundamental research in plate tectonics or maybe a great deal of it was done at institutions on the east coast, not necessarily on the west coast where we have the most immediate effects of the plate movements in our earthquake structure. Is that correct?

Dr. Pomeroy. That is correct, and that is partially, of course, because much of the input for the plate tectonic theory came from studies in the oceans. There are some very talented people at my institution, not including myself, who have been in the forefront of that activity for many, many years.

Mr. Brown. Because of the time pressures, Dr. Pomeroy, I am going to move on to the other witnesses.

Dr. Kunreuther.

[The biographical sketch of Dr. Kunreuther follows:]

BIOGRAPHICAL SKETCH OF

HOWARD KUNREUTHER

Howard Kunreuther received an A.B. from Bates College and Ph.D. in Economics from the Massachusetts Institute of Technology. After spending a year on a Fulbright Scholarship in the Netherlands, he was an economist at the Institute for Defense Analysis from 1964-1966. He came to the Wharton School, University of Pennsylvania in 1972 after being an Assistant Professor at the University of Chicago. Since 1977 he has been Chairman and Professor of the Department of Decision Sciences at the Wharton School.

Professor Kunreuther has published articles and several books and monographs on the economics of natural disasters. He has consulted with federal agencies concerned with natural hazards and served on National Academy of Sciences panels concerned with the socioeconomic consequences of natural disasters. He is a member of Phi Beta Kappa, the American Economic Association and the Institute of Management Science where he serves as an Associate Editor.

## STATEMENT OF DR. HOWARD KUNREUTHER, UNIVERSITY OF PENNSLYVANIA

Dr. KUNREUTHER. Thank you, Mr. Chairman.

It is a pleasure to have the opportunity to share my views with the Committee on Science and Technology on the major socioeconomic problems associated with earthquake hazard mitigation programs.

A group of us at the University of Pennsylvania in conjunction with colleagues at other universities and research institutions have recently completed a study on the factors which lead some people in hazard prone areas to protect themselves against the consequences of floods and earthquakes by purchasing insurance, and have examined the implications of these findings for policy. This study and others which have been funded by the National Science Foundation have increased our understanding of human behavior.

They have also reinforced my conviction that there is currently a need to integrate findings from the social sciences with the large body of knowledge on earthquakes and other natural disasters from the physical and engineering sciences.

To make the case that the social sciences have a vital role to play in natural hazards research, I will develop a conceptual framework or propose a conceptual framework for organizing current research findings and suggesting interesting future research directions.

In particular, the framework should enable policymakers at the local, State, and Federal levels to understand how people protect themselves against hazards, such as floods and earthquakes, and what the implications of these findings are for developing more effective hazards mitigation plans and recovery programs.

What I would like to do, with your permission, is to outline the framework. We can then go through an analysis rather rapidly as to what these boxes actually mean.

Mr. **Brown**. Dr. Pomeroy, I understand you have a plane to catch, and we do appreciate your staying with us as long as you have.

Dr. **Pomeroy**. Thank you.

Dr. **Kunreuther**. If we turn and look at figure 1, we will see that I have listed a set of strategies which are only several of many that could deal with natural hazards problems. Listed is the possibility of insurance and building codes and earthquake prediction.

The initial way of approaching the problem is to raise a set of questions associated with each of these strategies. For example, if we looked at insurance, one could ask: What will be the impact of alternative insurance programs for reducing future losses from earthquakes?

With respect to building codes, we would ask the question: What role can alternative building codes play in making existing structures and new construction safer in earthquake prone areas?

What are the potential problems and opportunities associated with earthquake prediction in reducing physical and human consequences from severe quakes?

What I would like to do is focus primarily in my oral testimony on the insurance strategy. I have written testimony suggesting ways to begin to look at building codes and earthquake prediction. My own expertise is primarily in the insurance area, and I thought I would try to share some of the views with you on these different columns within the framework.

Let us begin, first of all, with the current scene. My feeling is that before one can do interesting social science research, one has to understand what currently exists, and particularly to understand how relevant organizations are structured. We need to know what information is available regarding the particular strategy and how the data is disseminated and processed, and we have to understand the existing legal and political constraints and opportunities.

If we think about the insurance options, there are several results as seen from slide 1 that have emerged from our study, which may be useful to look at.

Three key results have come about from our understanding of insurance. The first result is that few individuals in hazard-prone areas voluntarily purchase insurance against earthquakes, or floods, for that matter. We have a good deal of evidence that has come out of our field survey research which gives us a better understanding as to why.

Most people who do purchase coverage do so after a disaster rather than prior to a disaster, something that contradicts the notion of insurance in general. We would have expected people to buy the coverage beforehand.

The question that has to be addressed is: What are current views of insurance industry and financial institutions in promoting coverage?

Once we begin to understand a little more substantively the current scene, we can begin to ask questions as to what future opportunities exist.

What I have listed in slide 2 are three general types of programs that could emerge with respect to hazard mitigation. One of them would be a program of free choice through market mechanisms. A logical example would be a voluntary insurance program. If an individual or business would like to buy coverage, they can; if they do not, then they will have to put up with the consequences.

A second opportunity would be incentive systems. One example here is the possibility of Federal reinsurance to protect earthquake companies against catastrophic losses. The insurance industry has been concerned about the consequences of actively marketing earthquake insurance because of the possibility of suffering rather severe losses if an earthquake occurs in a highly populated area.

Whether or not Federal reinsurance is the right way to go, it is a policy that one might want to begin to look at as an option.

The third general program relates to specific regulations. One possibility here would be for banks to require insurance as a condition for mortgage. None of these suggestions are ones where there are final answers.

I want to emphasize that with respect to the framework we are trying to develop. The social sciences can offer an opportunity to do research that will give us a perspective, and offer us a menu to look at the tradeoff between the different options.

In particular, I would like to emphasize the stakeholders that one may want to examine in the context of any of these particular policies. This is what I would label under the column "Role of Social Science Research" in slide 3.

We have to understand and evaluate the impact of alternative policies and programs on each of these groups.

Group No. 1 would be residents and businesses in hazard-prone areas. How would they be affected by any one of these policies?

The second relevant group is the general taxpayer, not only the people living in the hazard-prone areas, but other people in various parts of the country who may have to foot some of the bills associated with whatever program will be put forward, whether it be disaster relief, some form of subsidized insurance, or other kind of coverage. A program will have to be looked at from the point of view of how would they fare.

The third group wou'd be businesses dealing with hazard problems. By "businesses" we refer to the insurance industry and other groups that are associated with marketing particular policies. In the case of insurance there are a whole set of questions which will have to be raised as to how they will deal with a particular program.

The fourth group would be the Government agencies at the Federal, State and local level, all of whom have to begin to think about how they would cope with a given program mixture of strategies.

The last group is the U.S. Congress that has to begin to think about how a particular policy will impact on other considerations.

So the message that I feel is important from the social science point of view is that we do not have any definitive answers by saying this is the right way to go. What we can provide is a way of approaching problems, collecting data, examining a number of different alternatives, and then giving the policymakers an understanding as to how they can better approach the situation.

I would like to summarize with this final slide where I have listed what I consider to be two critical ways that social science research can play a vital role in hazard research. First is to help understand behavior of individuals, groups, and organizations in the pre- and postdisaster period.

The second point is to provide valuable data to enable policymakers to formulate and evaluate alternative hazard policies.

It is in this spirit that I would like to conclude my testimony.

[The prepared statement of Dr. Howard Kunreuther is as follows:]

# Statement By

Dr. Howard Kunreuther
Professor and Chairman

Department of Decision Sciences
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BEFORE THE

HOUSE SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY

on

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Good afternoon, Mr. Chairman, I am Dr. Howard Kunreuther, Professor of Decision Sciences at the Wharton School, The University of Pennsylvania. It is a pleasure to have the opportunity to share my views with the Committee on Science and Technology on the major socioeconomic problems associated with earthquake hazard mitigation programs. My initial interest in natural hazards research began in 1964 when I undertook a study with Douglas Dacy on the recovery problems facing Alaska after the 1964 Good Friday Earthquake. Since that time I have become increasingly interested in the options open to the public and private sectors regarding hazard mitigation and relief measures.

A group of us at the University of Pennsylvania in conjunction with colleagues at other universities and research institutions, have recently completed a study on the factors which lead some people in hazard-prone areas to protect themselves against the consequences of floods and earthquakes by purchasing insurance, and have examined the implications of these findings for policy. This study and others which have been funded by the National Science Foundation, have increased our understanding of human behavior. They have also reinforced my conviction that there is currently a need to integrate findings from the social sciences with the large body of knowledge on earthquakes and other natural disasters from the physical and engineering sciences.

To make the case that the social sciences have a vital role to play in natural hazards research, I will develop a conceptual framework for organizing current research findings and suggesting interesting future research directions. In particular, the framework should enable policy makers at the local, state and federal levels to understand how people protect themselves against hazards, such as floods and earthquakes and what the implications of these findings are for developing more effective hazards mitigation plans and recovery programs.

Figure 1 provides an overview of the framework. To cope with the problems associated with natural hazards there are a set of strategies or measures which can be pursued. I have listed three possible strategies associated with the earthquake problem: insurance, building codes and earthquake prediction. Although I will be looking at each strategy individually to illustrate the framework, an effective earthquake hazard mitigation program is likely to rely on a combination of these measures along with others such as land use regulations or disaster relief.

In looking at each of the strategies there will be a set of questions which social science research can address. Let me illustrate for each of the above options:

1. What impact will alternative insurance programs have on reducing future losses from earthquakes?
2. What role can alternative building codes play in making existing structures and new construction safer in earthquake prone areas?
3. What are the potential problems and opportunities associated with earthquake prediction in reducing physical and human consequences from severe quakes?

| STRATEGIES ↓ | CURRENT SCENE | FUTURE OPPORTUNITIES | ROLE OF SOCIAL SCIENCE RESEARCH |
|---|---|---|---|
| INSURANCE | | | |
| BUILDING CODES | | | |
| EARTHQUAKE PREDICTION | | | |

Figure 1

Conceptual Framework for Social Science Reserach on Hazards

To answer these and other questions we first have to gain a better understanding of the current situation. We can then look to future opportunities. Social science research can play a key role in linking the current scene with the future. Hence the three columns delineated in Figure 1. I will now illustrate the type of questions which must be addressed for each of the options considered above.

An understanding of the current scene requires us to know how the relevant organizations, individuals and groups concerned with the particular option are structured. Furthermore, we need to know what information is available regarding a particular strategy, how these data are disseminated and processed by each of the groups. We also need to understand existing legal and political constraints and opportunities. To illustrate consider each of the three strategies listed in Figure 1.

With respect to the insurance strategy we need to understand when individuals are likely to protect themselves against events such as earthquakes which have a small chance of occurrence but may cause potentially severe consequences. The results of our study (Kunreuther, et al., 1978), where we conducted face to face interviews with 1,000 homeowners in earthquake prone areas of California, half of whom were insured and the other half uninsured, revealed that most people are only interested in buying earthquake insurance after a disaster occurs rather than prior to the event. We need to know what the current views of the insurance industry and financial institutions are in promoting earthquake coverage or requiring insurance as a condition for a mortgage given their knowledge of this type of behavior.

With respect to building codes we need to understand how effective existing codes have been in reducing damage from earthquakes. What are the alternative options for making structures safer? How much extra will it cost to strengthen existing structures? Will the potential benefits from undertaking these measures justify the extra costs which the homeowner or business would be asked to bear in terms of increased rent? We can profitably study the political dynamics of successfully implementing building codes in California communities such as Long Beach, California. How instructive are these lessons for other areas in the U.S.? What are the existing codes in regions of the country where there have not been severe earthquakes in recent years such as Missouri, South Carolina and Massachusetts? Finally, what legal considerations impact on building codes?

With respect to earthquake prediction we need to know how individuals, organizations and governmental groups are likely to process information on a forthcoming prediction. In what ways will behavior by residents and businesses in a community differ if scientists predict that a quake is likely to happen in the relatively near future, or if the expected date is three to five years away? In what form, should information be released to the public if there is great uncertainty as to when and where an earthquake is predicted to occur? Some insight into the answers to these questions are likely to be provided by a study nearing completion at the University of California in Los Angeles. In this project extensive interviews with 1,450 adult residents of Los Angeles were undertaken in 1977 approximately one year after the first announcement of an Uplift in Southern California, which was thought by the U.S.G.S. to presage an earthquake. Preliminary findings are described in Turner et al. (1979).

Once we have an understanding of the current situation with respect to particular strategies we can turn to future opportunities for hazard mitigation. Programs for coping with the socioeconomic problems associated with natural hazards can be classified under three broad headings:

1. Providing individuals with free choice through the use of market mechanisms;
2. Providing government incentives for encouraging certain activities through subsidized programs or levying fines to discourage certain activities;
3. Enforcing specific regulations to control certain actions.

The effectiveness of each of these approaches can be best understood by first understanding the current situation and then evaluating how different strategies would perform under alternative programs. The three strategies listed in Figure 1 can be used to illustrate this point.

With respect to the earthquake insurance strategy, social science research can provide insight into the type of individuals who are likely to purchase coverage if they continue to have free choice as to whether they want to protect themselves. As an alternative one could examine alternative incentive systems for encouraging the purchase of earthquake insurance. One possible option is for the government to provide protection to the insurance industry against catastrophic losses through some type of federal reinsurance program. This would alleviate industry fears that they will be financially crippled if they encouraged homeowners to purchase coverage and a severe quake occurred in a populated region. Another alternative is for banks and financial institutions to require earthquake coverage as a condition for a mortgage in earthquake prone areas just as flood insurance is required today in flood prone areas. If, as we have learned through our recent research, homeowners are not likely to voluntarily protect themselves against earthquake damage this may be a worthwhile regulation to consider. The insurance industry, however, may resist this proposal unless they have some guaranteed protection through reinsurance against catastrophic losses. From this example, it should be clear that future opportunities may involve the use of several different programs: voluntary coverage for those who currently have a mortgage, and government reinsurance as an incentive for the insurance industry to require coverage as a condition for a new mortgage.

Turning now to the building code strategy, a similar set of questions can be raised. If a program relied heavily on free choice with a minimum of regulations, then there would be a need to provide residents with accurate information on the relative safety of their current structures or ones they are planning to purchase or build. Such an approach requires a better understanding as to the effectiveness of recent legislation such as the Alquist-Priolo Act which provides information about fault location and activity in Special Studies Zone. Do these studies lead to voluntary adoption of better building codes by developers? Can incentives such as reduced insurance premiums on better constructed buildings lead to safer structures without having to resort to specific regulations? These questions have to be answered in order to develop meaningful strategies with respect to building codes.

A brief look at the strategy of earthquake prediction yields a similar set of questions. If information on a prediction is released to the public and there are no additional incentives or regulations to deal with the impact of the prediction what type of behavior is likely to result? If would be useful to know under what type of predictions and for what kinds of communities there is likely to be severe concern and instability following a prediction and under what circumstances the prediction will produce minimal socioeconomic consequences. In cases where prediction produces some concern by residents and businesses in the communtiy about the safety of their lives and structure, what types of incentives and regulations may be appropriate to consider? For example, if people are worried about the ability of their structure to survive a damaging quake, information could be provided on the type of structural improvements which could be made. Low interest loans might be made available as an incentive to undertake these actions and special regulations might be considered as to the location of new structures and the type of codes that should be enforced.

In discussing the future opportunities for each of these strategies, it should be clear that they cannot be looked at in isolation from each other. A meaningful hazard mitigation program should combine several strategies. For example, if an earthquake prediction is made then there is a need to investigate how earthquake insurance, building codes, land use regulations and disaster relief can meet specific goals and objectives of an earthquake mitigation program. The Federal Emergency Management Agency (FEMA) in conjunction with the National Science Foundation (NSF) can play an important role in this regard. FEMA and NSF can help determine priorities for future studies. FEMA would be an ideal agency for coordinating data from earlier research efforts so that future projects can take advantage of known findings. Finally, FEMA can provide guidance on appropriate institutional and political contexts for analyzing alternative strategies.

Turning now to the last column in Figure 1, social science research has an important role to play in describing the current scene and evaluating future opportunities. In particular, the methodology of the social sciences can investigate the performance of alterantive policies and programs. Have current policies achieved their anticipated results? If so, was it because individuals and institutions performed as expected or were there other reasons that had not been anticipated? If the desired results were not achieved, what caused the policy to fall short of expectations? What can then be done to improve the situation? To answer these questions we need to pay attention to the impact of alternative policies and programs on the following different constituencies:

1. residents and businesses subject to the hazard in question;
2. the general taxpayer who may have to pay part of the disaster bill;
3. businesses and industrial concerns such as the insurance industry; financial institutions, the construction and real estate industry who are involved and affected by hazard mitigation and recovery programs;
4. state, local and federal government agencies concerned with hazards; and
5. the U.S. Congress who passes legislation on hazards.

The challenge for future social science research is to analyze the impact of different strategies and programs on these different constituencies. In order to do this there is a need to understand how individuals behave and institutions operate under different circumstances. To illustrate these points consider the insurance strategy.

Research on the consumer demand for flood and earthquake coverage indicates that few individuals are interested in purchasing coverage voluntarily even if rates are highly subsidized as they are in the case of flood coverage. With respect to the earthquake problem, several policy options are open to consideration. For example, earthquake coverage can continue to be voluntary. There is then the question as to whether victims who do not purchase a policy should be eligible for disaster relief as they have in the past. An alternative option is to require insurance coverage as a condition for a new mortgage.

Research in the social sciences is *not* designed to specify a correct policy. Rather its principal role is to indicate a menu of alternative policies and specify the tradeoffs which are likely to result if one chooses Policy A over Policy B. For example, if insurance was voluntary and liberal disaster relief was provided to uninsured victims, then the general taxpayer would be paying for some of the disaster costs of those in hazard-prone areas. User groups such as government agencies and the U.S. Congress have to make the appropriate value judgments as to who should pay for these disaster costs, how much each constituency should pay, and what actions can reduce future losses and disaster costs.

In summary there are two principal ways that social science research can play a vital role in natural hazards research:

1. it can help us better understand how individuals and organizations behave prior to a disaster as well as after the event;
2. it can provide valuable data on these decision processes to enable policy makers and interested users to formulate and evaluate alternative polcies.

By integrating the findings from the social sciences with those of the physical and engineering sciences, I am optimistic that more effective hazard mitigation and recovery programs can be designed by the public and private sectors in the future.

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Mr. BROWN. Thank you very much, Dr. Kunreuther. You have certainly made clear that there are researchable problems in this area which deserve attention.

The question which we are attempting to come to some better understanding of is within the framework of the overall earthquake hazard mitigation program. Are we getting an adequate balance with regard to the various research components?

Our general impression is that we are bypassing the kind of research you describe in favor of what is more popular and more easily understood, the fundamental research on the geophysical and the structural needs and so forth. I would like your opinion on that question if you have one, sir.

Dr. KUNREUTHER. I appreciate the opportunity to speak to that point, sir. I do feel that what is really needed now is the integration between the physical and engineering sciences and the social sciences. I do not think one group can operate without the other.

There are real opportunities it seems to me, particularly in the earthquake hazard area, to begin to ask a set of questions that rely on what we know from the point of view of physical phenomena and what we know in terms of possible building code measures that can improve structures. We must link this knowledge to our understanding of human behavior in the economic sense, as well as in the psychological and emotional sense.

When I say "psychological and emotional sense", I am really particularly referring to the problems that we have in processing information.

One of the main findings that has come out of the research that a number of us have been undertaking over the last few years is the tremendous difficulty in getting people to pay attention to the consequences of the low probability, high loss event. And what has struck me, having been trained as an economist, is that the market mechanism does not work as well as one might expect. We have begun to find that in low probability situations it is hard to get people to think rationally about events which have some very severe consequences.

We can begin to start asking questions such as: what can we do? Now, when we know physically what may happen and we know what the options are in terms of how we might proceed, we do have an opportunity to then creatively examine a variety of different policies to cope with the social consequences. And it is in that sense that I think we need better balance between the social science research side and the existing funding that has gone to the engineering and physical sciences.

Mr. BROWN. It seems to me we are beginning to build up a base of knowledge there which has applicability across a broad spectrum of problems. For example, we are quite accustomed to thinking of risk assessment in terms of agriculture where there are areas in which it is not unusual that one crop out of three or one crop out of four will be destroyed by a catastrophe of some sort.

And the Congress has just within the last few weeks accepted the challenge by creating a national crop disaster insurance program to replace a preexisting, rather inadequately structured program of disaster relief payments. In other words, they have substituted the insurance concept for the other concept that we use.

Now, it seems to me as we learn better about the risks in various areas of activity, we are better able to structure this into a strategy which will allow us to cope better with this particular set of problems, but we do not seem yet to have gotten to the critical point of seeing this as a total picture.

Dr. Kunreuther. I think that is quite correct. In fact, one of the real opportunities in the hazard area is that you have a specific problem where there are a number of potential strategies, for coping with it. I think if we begin to ask the questions, what are the tradeoffs between insurance and disaster relief, who will be helped and who will be hurt in each of these different situations, where are there analogies between what we have learned from the earthquake problems to the agricultural problems and general problems on the preventive health side, I think the significance of the work in the hazards area can be somewhat broadened.

So I very much applaud the general notion of thinking about this in very general terms and asking what the tradeoffs are between different options and how can they can be combined. How can we, for example, combine insurance with disaster relief? One strategy might very well be that some disaster relief be provided to the low-income residents who cannot afford to purchase insurance. You might have a different strategy for a higher income bracket; the older residents, people over 65, might deserve some special treatment with respect to disaster relief even though you may have a general option that would stress other possibilities.

Mr. Brown. All right. That is very useful to us.

If I may, I would like to go on to Dr. Wyner now.

[The biographical sketch of Dr. Alan J. Wyner follows:]

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## STATEMENT OF DR. ALAN J. WYNER, UNIVERSITY OF CALIFORNIA, SANTA BARBARA

Dr. Wyner. If I may indulge in a short comment, I want to tell you that in a perverse way I enjoyed the fact that you had to adjourn this hearing. I am currently teaching a freshman American government course, and by coincidence yesterday I gave a lecture about the House of Representatives in which one of my major points was the difficulty of coordinating the activities of 435 individuals. You have just provided me with a [good] anecdote for my next lecture.

Mr. Brown. I am glad you got something out of it.

Dr. Wyner. Thank you, sir.

But I would also like to talk, of course, about the subject matter of the hearing, and what I would like to do in a short period of time is to share with you a few thoughts about some research that I have had underway for some time, and some thoughts similar to Dr. Kunreuther with respect to the role of social science in the area of hazard research, and specifically earthquakes.

It is fair to say that there has been a noticeable increase in the social science attention to the impact of natural hazards. I want to address that more fully in a moment, but now I would like to discuss one such research effort, and that is the one that I have been involved in, along with my colleague Dean Mann.

We have been looking at the seismic safety planning efforts of selected local jurisdictions in California. By "seismic safety planning efforts," I am referring to the whole range of things that jurisdictions might do to mitigate earthquake related risks. We start from the proposition that there has been very little empirical research conducted to try to ask some simple sounding but important questions, such as what happens after legislation is passed? What is the impact of the legislation, such as we have seen in California? Does a community's experience with an earthquake make a difference or to put it differently, what are the long-term, if any, planning consequences that grow out of an earthquake?

We have selected a series of communities to examine. We have divided them into two basic types, those jurisdictions that have had recent—the last decade—experience with an earthquake, and those communities that have not. Therefore we are looking at six jurisdictions in the Los Angeles area that experienced damage from the 1971 earthquake, and we are looking at a metropolitan area—Alameda County—in California that has not experienced an earthquake in recent times.

We are also looking at two separate cities; namely, Santa Rosa, which of course did have a damaging earthquake in 1969, and the city of Salinas, which is clearly at risk but has not had a damaging earthquake in recent times.

That is the framework of what we are doing. Let me share with you for a moment a few general comments about a part of our research. I think it is very clear that those people that we interview—and I should say we have interviewed what we feel is a representative sample of the leadership both in the public and the private sector in these communities—almost universally agreed that in their perception the public has very little concern or regard for earthquakes.

The reason I think that becomes important is because particularly in the public sector, given all of the competing interests and attentions on public officials, what that perception does is feed and translate into their own attitudes. That is, the city council members, the planning department directors, commission members, building officials, et cetera, have developed their own beliefs that earthquakes are not of serious concern to them.

Or to put it another way, on a priority list, they do not place seismic safety matters anywhere near the top. Indeed, as several of these public officials, have told us, seismic safety would not make any list of any priorities. This has carryover consequences, I think, for the whole attitude and atmosphere in which local jurisdictions in California approach seismic safety concerns.

We would conclude that building department activities perform a critical role in any effort by a community to be concerned about seismic safety. It is interesting that the central role of building officials is enhanced by the fact that their colleagues in other departments, particularly planning departments, talk very extensively about the need for "engineering away" seismic related problems.

In other words, that engineers can design around earthquake related problems is the very clear message that is given to us by planners and planning commission members and indeed many city council members. What this attitude does is, in effect, dump it in the building department.

Because it is an engineering problem, it is not serious. We are told, "They argue about numbers on a piece of paper and they come to the right answer."

It is not that simple, of course, and one of the reasons is because what building officials do can be very controversial and can have widespread impact, and there is no better way to look at that than to think about the old buildings problem in California. The old buildings problem represents one of the most, if not the most, serious threats from earthquakes to life and property in California.

And yet at the same time, old buildings is an issue, that generates more political controversy than others, because the property owners who feel threatened by the potential cost and work involved are usually in most communities very influential people. And in the few communities in which we have seen discussions—and that is really all it has gotten to, discussions and drafting of ordinances—of attempts to deal with the problem, we have found a very interesting and perhaps unholy political coalition of property owners, tenants, and the users of these structures.

These are the people who argue against the rehabilitation or demolition policies that might be adopted to deal with these old buildings because these policies would, of course, reduce the risk at a cost and an inconvenience to them.

It strikes me that it may in fact be politically impossible for local public officials to act on the old buildings problem. What I would argue is that to the extent this is a problem we should address, it may be one of those cases where action at the local level will occur only as a result of mandates from higher levels—the State or Federal Government.

But the minute you say that, you have to recognize the widespread opposition to such mandates that was expressed to us in the course of our research. There was noticeable opposition to the State or Federal Government taking a greater role in local building ordinance enforcement. Indeed, I think it is very clear that local political and appointed officials, local construction industry people, and local real estate people, and all of those involved with development in local communities, will probably fight strenuously against concerted, strong efforts by ligher levels of governments to get involved in building code enforcement.

I have been skimming over some of the kinds of topics we are examining. In the interest of time I would now like to take the liberty of offering a few concluding observations without really giving you much evidence or data for these observations.

At a very fundamental level we would conclude those governments which have experienced recent earthquake, do in fact seem to have done more in preparing for the next one than those in communities that have not experienced an earthquake in recent times.

Earthquakes do seem to make some difference, but at the same time it would also be my conclusion that in no community we studied has there been an accomplishment of all that our laws and our technology would suggest that we could accomplish.

And so what I am really saying is that there has, in fact, been noticeable progress by some local governments, particularly those that have experienced recent earthquakes, but there is also a very concerted and continued inaction by many local governments.

Now a couple of comments that I suspect will get some people a little upset. I think we have to change some of our approaches as to how we think of seismic safety. One of the most frustrating experiences for those individuals who try to reduce our vulnerability to future earthquakes is their inability to keep seismic safety at the top of the public agenda, and keep it as an important issue.

I would suggest that their frustration may be reduced and their overall level of achievement may be greater if we acknowledge that maybe seismic safety should not be a high priority item in some communities. Maybe in fact there are more important topics that should be higher on the public agenda.

I am suggesting much more selective attention to certain communities and/or certain specific issues in the seismic safety area might prove more rewarding than a frontal attack on everything all at once in all communities.

And that leads to a similar comment I would offer with respect to attempted comprehensiveness. I have often heard it argued that the only significant breakthrough in seismic safety or risk reduction will come through the development, presentation, adoption, and implementation of some comprehensive seismic safety policies, policies that deal with all the known permutations and interactions with everything involved with respect to seismic safety. Frankly, I do not think our political system works that way. We probably have to live as a practical matter with an incremental, piecemeal approach and somehow have faith that the collectivity of action adds up to reduced risk.

What I am suggesting with respect to policy is that it may be more productive for us to develop policy that, in effect, says we are not going to be all comprehensive, but instead we are going to focus on some carefully selected and clearly defined parts of the overall seismic safety problem.

A couple of concluding comments, if I may, similar to what Howard Kunreuther was saying. I would like to just suggest to you, Mr. Chairman, that I see three areas that social science can make a contribution to seismic safety, and I would enumerate them.

In the first place, it seems we can make a contribution to public policy by the identification of problems in a policy-relevant fashion. I think we can also increase our understanding of how policy is made and, therefore, how we might use, adapt, mold and, if you will, even manipulate the political process to accomplish goals that we have in mind.

And third, I think the contribution of social science research can come about through the articulation of alternative approaches to problem solving. Not the "right" answer or "the" answer that should be adopted or all hell will break loose, but alternative approaches and some of their consequences laid out before policy makers. I think we can make that kind of contribution, and I think there are several areas of fruitful research direction we can go in. I would like to enumerate a few of them without discussing them.

I think we clearly have to give more attention to strategies and techniques for improveng the quality of building code implementation and enforcement.

I think we have to look more carefully and over a long period of time the implications of earthquake prediction on our social, economic, and political system.

We simply must learn more about how seismic safety policy is made, and what decisions have been forthcoming in areas other than California. It is true, of course, as we just heard that there have been concerns about earthquakes in the Midwest and East from engineers and seismologists. I do not think we know much about public policy in other areas of the country.

I think we also have to understand more about the financial incentives which would be helpful in alleviating some problems, such as old buildings and unstable land.

I would like to single out one particular locale back in California that I think we—collectively—have been negligent for not looking at more carefully, and that is Long Beach, Calif. They have done some things with respect to building rehabilitation in that city. We do not know very much in a systematic, organized, careful, and objective fashion about the consequences of their efforts to rehabilitate old buildings. Obviously they have had some successes and some failures. That program had an impact in that community, and we should know more about it.

Lastly, I would suggest that we should give more attention to trying to understand the way in which emergency preparedness planning efforts can be improved at the local governmental level.

Let me conclude if I may by simply saying again I think there is an increase in social science interest. It is a small increase, but nevertheless an increase, and one of the reasons has been the availability of money. How many more dollars we need I cannot tell you, but we do need money.

I think there is a genuine demand and a genuine need for social science research support, but also at the same time I would like to enter a caveat. We should be careful that we do not assume that putting tremendous sums of money into a program is automatically going to generate appropriate research. To be quite frank with you, I am disappointed so far by the response of the social science community in terms of their interest in natural hazard problems generally, and with respect to earthquakes.

It will take awhile, given the nature of the academic community and the private planning "think tank" community, to turn them around to a realization that there are interesting theoretical and practical questions to deal with, and in fact, there is money to support it. It will not happen quickly, but it will happen, I am convinced, over the next several years.

Thank you.

[The prepared statement of Dr. Alan J. Wyner is as follows:]

# SOCIAL SCIENCE RESEARCH AND SEISMIC SAFETY POLICY

Testimony of
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to
Subcommittee on Science, Research and Technology
Committee on Science and Technology
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In a small but quite perceptible way social scientists have been increasingly turning their research attentions to natural hazards. In particular, earthquakes and their consequences for the social, economic and political systems offers exciting research opportunities for the social science community. This research almost invariably acquires an applied focus and is therefore of potential interest and importance to public and private policy makers. My comments this afternoon grow out of a conviction that the knowledge and styles of analysis common in the social sciences can make an important contribution to the development of public policy in the earthquake hazards reduction area. After presenting a brief account of my own research, I want to offer a few comments about the importance of this type of research and also some suggestions for future research directions.

For the past two years my colleague Professor Dean E. Mann and I have conducted research on the seismic safety planning efforts of selected California local governments. The research is supported by the National Science Foundation. I should point out that when we speak of seismic safety planning we mean the entire range of potential activities and policies a local jurisdiction may take to mitigate earthquake related risks. Because we have not yet finished writing our final report, I would appreciate it if my comments were taken as preliminary.

There has been little, systematic empirical research which has explored the impact of existing seismic legislation. Not much is known about the way in which local communities plan for earthquakes, why some communities seem more interested than others in such planning and preparation for earthquakes, or whether recent experience with an earthquake makes any difference for subsequent planning activities. We have developed a set of research issues designed to guide our investigation of the factors which may account for different kinds and amounts of seismic safety planning. The demographic and socio-economic nature of the community, effectiveness of its planning and building inspection process, the recency and magnitude of an earthquake, attitudes of public officials and local influentials and other variables are being examined. The research focuses on two pairs of areas having important similarities, and in some cases, significant differences: two areas which have had earthquakes within recent times are being compared with two similar areas which have not had experience with an earthquake recently.

TABLE I: Research Sites

| | With Recent Earthquake Experience | Without Recent Earthquake Experience |
|---|---|---|
| Metropolitan | County of Los Angeles<br>City of Los Angeles<br>San Fernando<br>Burbank<br>Glendale<br>Simi Valley | County of Alameda<br>Oakland<br>Hayward<br>Fremont<br>Berkeley |
| Single City | Santa Rosa | Salinas |

Since the areas we have chosen to study are not matched pairs but rather areas that share certain similar characteristics, we are being careful not to appear dogmatic about the impact of the two key organizing variables--namely, recency of experience with an earthquake and being located in a metropolitan region or not. We think these two factors are important explanatory variables but we recognize the "softness" of our design because we do not have perfectly matched pairs of areas.

Our data collection efforts have been varied. After developing an historical profile of the communities chosen for research, we then proceeded to an accumulation, understanding and analysis of virtually all the documentary record of importance in each jurisdiction. A plethora of various reports, memos, correspondence, ordinances, minutes and transcripts of meetings and maps were studied. Once armed with this background information, we proceeded to personally interview several types of persons in each community: elected and appointed officials, relevant agency personnel and a variety of private sector persons such as bankers, insurance brokers, real estate brokers, architects, businessmen and officers of community organizations. We conducted over 240 interviews in the 13 jurisdictions. As I am sure is clear from my description of our respondents, we have not interviewed a representative sample of citizens in each of the research jurisdictions. However, we have tried to interview a representative sample of persons in positions of leadership in all sectors of each community.

The fundamental premise of our investigation is that there is likely to be friction in the governmental system in achieving seismic safety goals because of both the substantive costs and transaction costs to individuals, groups and communities. We are studying the sources, causes, and consequences of this friction. These costs can be measured in terms of income losses but also in terms of disruption in the patterns of social and political behavior to which people have become accustomed. Transaction costs will be found in the difficulties in achieving agreement on direction and speed of policy movement, particularly in terms of displacing other pressing policy issues from the political agenda.

After these brief introductory and qualifying remarks I would like to turn to some observations and tentative conclusions. I will comment only upon a small part of our research.

## Public Concern

There appears to be almost universal agreement among those we have interviewed that public concern for seismic safety is quite low; this is in accord with our own observations. Furthermore, it appears that public concern for seismic safety matters has not been evident anytime during the last decade except on two important types of occasions: 1) immediately after an earthquake and 2) when a specific development/building issue arises in a particular community where someone or some group introduces seismic considerations. Seismic safety appears on the public agenda infrequently and when it does it is usually only one of many points being discussed with respect to a particular decision on a particular development plan for a single parcel.

The responsibilities of city council members, planners, city managers, building officials, as well as persons responsible for emergency planning, necessarily sensitizes them on occasion to seismic safety as an issue. They are therefore more likely to place seismic safety at a higher level of concern than does the general public. Nevertheless, public officials, especially elected ones, do not rank seismic safety as an important, major community issue. They are far more concerned about issues such as taxation, traffic, crime, and economic development than a problem like seismic safety which has only a potential impact on their community.

City councils and other decision making bodies seldom (if ever) make clear-cut decisions on the level of risk they are willing to assume, despite recommendations found in Seismic Safety Elements (SSE) that they should do so.* Also, the terms voluntary or involuntary risk are not part of their vocabulary. The determination of the seismic risk that a community is "willing" to accept is made _de facto_ in the process of either implementing or failing to implement Seismic Safety Elements or in specific decisions that a community makes with respect to a given project. Perceiving the lack of resources and/or lacking the interest or stimulus to undertake a comprehensive program on seismic safety, there is simply no incentive to undertake a cost/benefit analysis of a seismic safety program that would reveal the level of risk to which the populations of a community are subject and which the decision makers are prepared to accept. The public might or might not tolerate the level of acceptable risk arrived at by the decision makers if such a clear-cut decision were made. The exposure of that decision might subject the public official to unacceptable _political_ risk, and so the whole subject is usually avoided. To be precise and thorough on this issue invites controversy and conflict, something hardly to be sought on an issue not even perceived as very important.

## _Land Use Planning and Zoning_.

Local government planning departments do not seem to play a very large role in dealing with seismic safety questions. Seismic Safety Element recommendations for planning and zoning in terms of seismic safety are not always acted upon and in some cases seem almost irrelevant to the decisions that are made with respect to the use of land and property.

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*California law requires every city and county to prepare a Seismic Safety Element (SSE) as part of their General Plan. The SSE is supposed to identify seismic hazards and, by implication, suggest corrective steps in the land use decision making process.

There seems to be a strong tendency for planners to believe that any land use problem involving seismic safety can be "engineered away." Seismic safety is therefore perceived by most planners to be the primary responsibility of the building department and only peripherally an issue for the planners.

Most jurisdictions in our research have adopted a SSE; a few still have them in draft form. Planners are very cynical about the SSE, characterizing them as "one more state mandate." They report very little impact resulting from the adoption of a SSE. By that they mean that they almost never refer to the SSE in the planning process or in making decisions with respect to individual parcels. The most planners are likely to say is that the SSE has "sensitized" them and others to potential seismic risk. I have the impression that planners are not always looking at the larger picture when they talk about the SSE. For instance, the adoption of a SSE and therefore the official recognition that there are faults and soil problems within a jurisdiction, has certainly led to approaches by private developers that take some of these conditions into account. Indeed, some planning departments won't accept development applications in certain areas without soils reports or evaluations by structural engineers.

What frustrates the planners is that they see the recommendations of the SSE for such things as more accurate mapping of faults, careful investigation of certain areas for soil problems, and occasionally prohibitions on development in certain areas ignored. Their cynicism about the value of the SSE seems to grow the longer a jurisdiction has an adopted SSE.

## Building Codes and Building Departments.

Building Department activities appear to be the critical elements in the seismic safety policy of a given community. The central role of building officials is enhanced by the fact that many other public officials tend to believe that virtually any seismic risk can be dealt with through engineering design.

There are two aspects to building codes and their enforcement--new construction and the older buildings of pre-1933 vintage. Taking new construction first, only a very distinct minority of the contractors, developers, architects and engineers we have interviewed expressed any dissatisfaction with the seismic requirements of the latest Uniform Building Code. Likewise, building inspectors don't have any serious criticism to offer about the code. Complaints about building code enforcement were of two kinds: 1) those in the private sector often suggested that building department personnel did not check plans as quickly as desired and were not always as prompt with inspections as desired; 2) building department personnel were uniform in their feelings that their workload and the complexity of the codes have increased and the staff size has not kept pace. For building inspectors seismic safety was one of several "new" requirements that have greatly expanded their job responsibilities. While expressing sympathy with the requirements of the seismic codes and also the need to update them periodically, it is clear that many building officials approach the seismic safety aspect of building code enforcement with an attitude of resignation rather than enthusiasm.

What about the quality of plan checking and site inspections? It is difficult for us to evaluate quality, so we must rely upon what we are told and some reading between the lines. As you might expect, it is our observation that quality varies greatly by jurisdiction: one good indicator of the seriousness with which a jurisdiction takes seismic safety is the kind and amount of professional talent which is directed at plan checking and site inspection. There are some jurisdictions where the submitted plans are only given a cursory review and the applicants calculations and designs are simply accepted at face value. Likewise, site inspections in some jurisdictions, even on fairly complex structures, are conducted by personnel without the background or training to make a thorough independent assessment of the construction practices. There are a few jurisdictions in our research which are generally viewed as having very competent, professional staff and inspectors. The level of complaints from the private sector seems to be greater in these jurisdictions.

There is considerable variation in the extent to which the jurisdictions in our study have sought knowledge about the unreinforced masonry building problem. Only Santa Rosa has adopted policy to rehabilitate or abate seismically unsafe buildings. The City of Los Angeles has recently conducted a survey of its old buildings and has written an ordinance which would correct many of the deficiencies which were discovered in approximately 8,000 older buildings. The City Council has ordered further study on the impact of this ordinance before it will consider its adoption. Salinas has had an engineering firm conduct a reconnaissance level survey of the old downtown buildings. Burbank and Hayward have conducted a "windshield" survey by driving or walking by the outside of suspected problem buildings. In sum, in most jurisdictions under study there is very little systematic, thorough knowledge about the extent or magnitude of the old building problem.

Of the questions and issues that have been raised about seismic safety in California during the last decade the old buildings issue is the one that is probably the most crucial in terms of threat to life and property. And yet, it is the issue about which little is known with any precision and even less is being done. No other issue of seismic safety generates as much political controversy because the property owners who feel threatened by the potential costs and work are in many communities very politically influential. And in a few communities which have begun discussions of the old building problem an unlikely political coalition of property owners, tenants and the users of these buildings has emerged to argue against rehabilitation or demolition policies which would reduce the risk at a cost and inconvenience to them. It may be politically impossible for local public officials to act on the old buildings problem. To the extent that it is an issue that "should" be handled, it may be one of those cases where action will occur at the local level only under force of a mandate from a higher level of government. Lest anyone think that this prospect--of state or federal action on old buildings--will happen quickly or easily, I would like to point out that both private sector respondents associated with the construction industry and all public officials we have interviewed were unanimous in their opposition to the state or the federal government becoming involved in the old building question. They will fight rather than switch.

This very brief description of a few aspects of our research can only serve to acquaint the committee with our approach. Without your having the opportunity to see all the evidence, I hope I can still take the liberty of offering a few concluding thoughts and observations which emerge from the research. At the most fundamental level, it is apparent that some communities are now better prepared to withstand an earthquake than they were a decade ago. The government of those communities that have experienced a serious earthquake within the last decade have taken steps that put their communities at an advantage compared to communities that have not suffered a damaging earthquake recently. At the same time, it is also our conclusion that no community we studied has accomplished as much as it theoretically could (or perhaps should) have, given the current requirements of our laws and the state of our technical knowledge about how to mitigate earthquake consequences. There has been noticeable progress by some local governments, but continued inattention to seismic risk by others.

In addition to previous experience with an earthquake, we find that the presence of certain knowledgeable, dedicated and politically attuned staff personnel provides a distinction between jurisdictions which explains why some cities or counties take a more aggressive stance vis-a-vis earthquake related risks than others. A city manager committed to abatement of old buildings hires a building official with the professional skills and motivation necessary to convince the city council that he should be given the opportunity to take serious action. Or that the fire department official who quietly works behind the scenes to make the emergency communications network more effective in a crisis. These and several other examples became apparent to us in the course of our research. We are persuaded that considerable progress toward effective seismic safety policy can be made by staff personnel who understand how to accomplish things without arousing serious opposition. This "inside" strategy is effective for many kinds of policies but clearly won't work (and shouldn't) on those issues which have major and visible impact on the community. Yet the accumulation of these minor accomplishments may make a significant contribution over several years.

One of the most frustrating experiences for those individuals who are trying to reduce our vulnerability to future earthquakes is the inability to keep seismic safety a highly visible and important policy issue. Their frustration may be reduced and the overall level of accomplishment may be greater if we acknowledge that maybe seismic safety should not be a high priority issue in some communities. Maybe there are more important topics that should be high on the public agenda, and that agenda can not be infinitely expanded. A more selective attention to certain communities and/or certain seismic safety policy issues might prove more rewarding than a frontal attack on all seismic safety issues in all communities at risk.

It has sometimes been argued that the only way seismic safety will ever become a high priority topic that will eventuate in "significant" risk reduction is through the development, presentation, adoption and implementation of a comprehensive seismic safety policy--a policy which deals with all the permutations and interactions of land use, building codes, emergency planning and public education. In many important ways our political system and many societal traditions run counter to comprehensiveness. We probably must live with an incremental, piecemeal approach and hope that the collectivity of actions adds up to reduced risk. Policy we develop should foresake the goal of comprehensiveness and instead focus on carefully selected and defined parts of the overall seismic safety policy area.

### Contributions of Social Science Research.

The comments above about my current research were not designed to be a full accounting of the research effort. However, by providing the committee with some indication of what a social science research effort on seismic safety might look like, I hope to have provided the background for an argument I now want to make. Social science research on natural hazards (and specifically on earthquakes) can contribute to public policy in three ways: (1) problem identification; (2) increased understanding of the policy making process; and (3) articulation of alternative approaches to problem solution.

One of the reasons why it is difficult to convince public officials--especially elected officials--to take action on seismic safety questions is because the earthquake caused problems are not always presented in a way which lends itself to policy decisions. To know that earthquakes kill people and cause some buildings to collapse does not by itself identify the problem in a way which clearly lends itself to problem solving by public officials. Drawing upon the expertise of engineers and earth scientists, social science research may help identify and define issues in a policy relevant fashion. For instance, I would submit that the problem with old buildings is not primarily an engineering one, but rather a problem of economic, social and political incentives.

The process by which public policy is made can be quite complex, even in relatively "simple" governmental structures such as you find in many local communities. On virtually any issue of any importance competing interests will emerge to express their viewpoints and lobby for their preferences. Social scientists--and in this case I think of political scientists in particular--can contribute to our understanding of how public policy on seismic safety is made; to describe and analyze the nature of the policy process and the way in which the policy process effects the choice of policy are classic analytic approaches in the social sciences. What difference for seismic safety policy does the existence of a tradition of politically active community groups make? What is the role of appointed planning commissioners in the formulation of seismic safety policy in comparison with the role played by elected city councilmembers? What is it about the political process of one community that "allows" strong seismic safety measures to be taken while another community's political process "prevents" the emergence of seismic safety onto the active public agenda? Understanding the answers to these and other similar questions can help those interested in seismic policy better understand the way in which policy is made.

In addition to helping identify problems in a policy relevant manner and aid in the understanding of how policy is made, applied social science research can articulate alternative approaches to problem solving. For instance, in my own research I am trying to develop recommendations for local government officials interested in improving their land use planning, building code enforcement and emergency preparedness functions. Social scientists engaged in this type of policy relevant research should not pretend to know all the answers, but we can point out different approaches and some of their consequences.

## Some Future Research Directions.

Many areas of fruitful social science research remain. I would like to enumerate some of them without, however, implying a ranking of priorities.

1. Strategies and techniques for improving the quality of building code enforcement.
2. Continued attention to the social, economic and political implications of earthquake prediction.
3. A greater understanding of how seismic safety policy is made and what decisions have been forthcoming in areas other than California, e.g., Puget Sound, Utah, Missouri Valley, Charleston, etc.
4. Increased understanding of what financial incentives would be helpful in alleviating some problems such as old buildings and unstable land.
5. A serious examination of Long Beach, California and its old building rehabilitation program; what are the consequences?
6. Ways to improve the emergency preparedness planning efforts of local governments.

I have purposely chosen to present a list of what I sense to be very applied types of research endeavors. However, mingled with these topics are questions of potential theoretical interest.

Measured either by amount of money spent or by the number of social scientists involved, there has not been a significant amount of social science research on earthquake related matters. The fact that it is increasing is in great part due to the increased availability of funding for such research. Support for social science research makes sense and it will ultimately provide useful knowledge.

Mr. Brown. Thank you. It is a very useful statement, Dr. Wyner, and I appreciate it very much.

One of the things that was going through my mind as I listened to you discussing problems of the seismic program was to substitute in my mind what if he would say nuclear programs because there are obvious parallels and similarities in what needs to be done.

For example, as a result of the Three Mile Island accident, there is a widespread awareness that we did not have adequate emergency preparedness planning efforts in the local community, and in terms of the impact of an accident or catastrophe, I do not know that there is all that much difference between a major nuclear accident and substantial earthquake.

They both would call into effect many of the same kinds of strategies and reactions in the community, and we are just not equipped to deal with them.

What I had hoped in nursing this program along in the original legislation was that the kind of research which you are describing could be encouraged, that its synergistic effects could be appreciated. I hoped it could apply to a broader range of planning and social response for emergency situations, and lead to an upgrading of our social competence as well as an upgrading of our social science capability.

I still hope that we can move in that direction. But it is a difficult thing to create an understanding of in the Congress.

You have that problem that you also referred to of whether you can get action more quickly by focusing on the broad general universe that you could be concerned with or a specific part of it which is, we will say, the earthquake hazard mitigation part. Which way are you more likely to get action?

Well, in California, you get action in connection with earthquakes, not broad planning programs, but responses to theoretical hazards. Earthquakes are a practical way of creating a sense of urgency in California. So we will continue to see if we can get some of these benefits on the program.

I am going to defer or refrain from asking specific questions of you gentlemen for reasons that I am sure you will understand and conclude by thanking you very much for your willingness to be here. I apologize for the long delay.

If we can get your assistance in case we need specific answers to further questions, we would like to call on you.

And now at 20 minutes to 6. I would like to call up the remaining members of the last panel, those members who had the stamina to remain here through all of this period.

May I say that we very much appreciate it. By some odd coincidence, you all seem to be Californians. You probably were not planning on going anywhere tonight, were you?

From the Floor. Not to California.

Mr. Brown. Doctor, I understand you are trying to catch a plane, and with that in mind, I would like to have you go first, if you would.

[The biographical sketch of Professor Steinbrugge follows:]

# KARL V. STEINBRUGGE

Born:

February 8, 1919
Tucson, Arizona

Education:

A. Reed College (Portland, Oregon)
1 year, 1937-38
Mathematics major

B. Oregon State University (Corvallis, Oregon)
3 years, 1938-41
B.S. in Civil Engineering

Academic Career:

Professor of Structural Design, Department of Architecture, University of California, Berkeley, 1950-1978. Professor Emeritus, 1978-.

Brief Professional Background:

Licensed Civil and Structural Engineer, California.

Major consulting -- Federal government:

1. U. S. Geological Survey (USGS), 1971 to date.
2. Environmental Science Services Administration (and predecessor organizations of NOAA and C&GS), about 1960 to 1970.
3. Housing and Urban Development (HUD), intermittantly from about 1970 to date.
4. Nuclear Regulatory Commission (formerly AEC), 1964-1980.

Major consulting -- state and local government:

1. San Francisco Bay Conservation and Development Commission, 1967.
2. California Legislature: Joint Committee on Seismic Safety, 1972.
3. Contra Costa Junior College District (construction program consultant), 1952 to 1969.

Professional employment:

1950-1980. Insurance Services Office, San Francisco. In charge of all of their earthquake engineering and research activities for United States. Work includes detailed engineering investigations of the probable earthquake damage to structures, and also studies of earthquake effects.

Public Service:

Federal agencies

1. Department of State, AID Program: A special study of the earthquake hazard in Caracas after the 1967 Venezuelan earthquake.

2. Office of Emergency Preparedness: Served on their Evaluation Board with respect to their 1967 study of earthquake hazard in San Francisco. A similar study for Seattle, Washington was evaluated at a later date.

3. Department of State and Department of Commerce: Chairman of a team of scientists and enginers which was sent to USSR in 1969 to investigate their state of the art of earthquake engineering and engineering seismology.

4. ESSA of Department of Commerce: Studies of numerous earthquakes. Including the 1964 Alaskan earthquake, 1969 Santa Rosa, California, earthquake, 1971 San Fernando, California, earthquake among others.

5. Office of Science and Technology, Executive Office of the President, Washington, D.C.: Chairman, Task Force on Earthquake Hazard Reduction, 1970.

6. U. S. Geological Survey: Member of a team which went to USSR to meet with Soviet counterparts on earthquake prediction problems. (1973).

7. Advisory Committee on Reactor Safeguards (ACRS) within Nuclear Regulatory Commission, consultant, 1964-date. (The ACRS is an agency established by Act of Congress.) The work concerns itself with the siting of nuclear reactors and other safeguards with respect to the earthquake hazard.

8. U. S. Geological Survey: Member, Earthquake Studies Advisory Panel, 1973 to date.

9. Office of Science and Technology Policy in the Executive Office of the President (chairing a Working Group on Earthquake Hazard Reduction), 1977-78.

10. U. S. Geological Survey: Member of teams which field investigated earthquakes in Nicaragua (1972), Guatemala (1976), and Roumania (1977).

Public Service (cont.):

State and local agencies

1. San Francisco Bay Conservation and Development Commission: Chairman of Board of Consultants on Safety of Fills, 1970-71. Member, 1971-72.
2. Tri-Cities Study on Earthquake Hazards, member of Advisory Board, 1973.
3. (State of California) Governor's Earthquake Council, member, 1972-74.
4. Legislative Joint Committee on Seismic Safety (California): Chairman of Advisory Group on Engineering Considerations and Earthquake Sciences, 1969-72. Chairman of Advisory Groups' Executive Committee, 1969-74.
5. California State Strong Motion Instrumentation Program Advisory Board, member, 1972-76.
6. California State Mines and Geology Board, member, 1969-76.
7. Seismic Safety Commission of State of California. Chairman, 1975-77; member, 1977 to date.

Publications:

Authored or co-authored approximately 100 articles, papers, and monographs. A listing of these publications is available upon request.

## STATEMENT OF PROF. KARL V. STEINBRUGGE, UNIVERSITY OF CALIFORNIA, BERKELEY

Prof. **Steinbrugge.** Thank you. I do appreciate this opportunity, and I will summarize my remarks.

Mr. **Brown.** The full text will appear in the record, Prof. Steinbrugge.

Prof. **Steinbrugge.** My background is that of a structural engineer and I have deeply enjoyed my chosen profession. But it became apparent some 30 years ago, as I became involved in earthquakes engineering matters, that a multidisciplinary approach was necessary to have any major effect on earthquake hazard reduction.

Over these 30 years, I have been involved in a number of successes and a number of failures. However, today I would like to speak only from the standpoint of my experience of having been chairman of two working groups in the Executive Office of the President in Washington, D.C., once in 1970 and the second in 1978.

In 1970 when I was in Washington, the studies conducted by my predecessors had already pinpointed the greatest problems; in 1978 many of the same problems and questions came up again. This latter effort has been quite successful due to having developed substantial insight into the problems. However, some of the major problems remain unsolved.

All this time I would like to focus my views a little bit more, with some emphasis towards a similar role in FEMA's predecessor organization, being the Office of Emergency Planning before it was split into a number of independent groups—only to be remerged at this time. Beyond question, FEMA has an extremely important role in earthquake hazard reduction. FEMA's mitigation role requires inputs from the physical sciences, engineering, land use planning, and social science, among others. In turn, FEMA should be and supportive and coordinative among these disciplines. Solutions to a few of the problems are substantially beyond the capability of specific jurisdiction, be it a city, county or even a State.

A great earthquake in Los Angeles with its enormous effects would overwhelm the State's capability to respond in any long-term sense. Clearly, the Federal Government must be involved through a great number of its agencies. FEMA's mitigation role is to reduce these effects prior to the event.

Actually I am not as pessimistic as a few of my colleagues testifying here today regarding the present status of the Western States. Also, I am not so pessimistic that we always need an earthquake to obtain necessary legislation. It certainly implements changes, and I have been opportunistic after each such event. However, on a recent trip to Albuquerque to visit some of my former architectural students, I remember saying, "Oh, you will have a disaster here with all of your masonary buildings". They replied, "But the new buildings are earthquake resistant. The problem is far less than you think." One former student took me for a tour around Albuquerque, and indeed, the unit masonry buildings under construction had steel sticking out of the cells. He further stated: "Some of us who went to school in Berkeley came back with the feeling that these hazards are real, and we have convinced our townspeople."

Albuquerque is in New Mexico which has a history longer than California and, indeed, perhaps rivaling much of the East for its length. But the Rio Grande Valley in New Mexico has never had a destructive earthquake in historic times. Clearly, we don't always need an earthquake.

For another example, the active Wasatch Fault goes through Salt Lake City, but building codes in that city are improving matters. Earthquake resistive buildings following current building codes are being constructed in Reno and Las Vagas, Nev., as well as in Phoenix, Ariz. Hazard reduction is proceeding, but progress is too slow.

In summary we have had some success, albeit poor and uneven, with new buildings. It is the older buildings that represent the greatest hazard.

Every time there is an improvement in a building code, we are by definition, increasing our inventory of legally hazardous buildings.

The number of these buildings is overwhelming to the large cities when considering hazard abatement procedures.

Let us consider one case in the city of San Francisco I would hope that each of you have been to San Francisco and visited its Chinatown. Most people who come to San Francisco visit that area. The streets of Chinatown are narrow, and the buildings are collapse hazard types in earthquakes. In an earthquake, we know that the streets will be debris strewn and rescue vehicles will not get through them. Further, it is a minority district, and also a low-income area. It is a "disaster waiting to happen" to lives, property, culturally, and historically.

Redeveloping San Francisco's Chinatown is a simply stated solution, but there are many difficult underlying problems. If we temporarily move these minorities (many do not speak English), we are creating a problem similar to World War II with its despised relocation centers. The cost of strengthening buildings is economically unfeasible, certainly in the context of the resources of the people who live there. Additionally, local pride and historic preservation will be further problems. As a San Franciscan, I would be among the first to object to a modern Chinatown, preferring the more expensive strengthening of existing structures.

Demolition and rebuilding, by themselves, are not the answers. It also, requires the involvement of the social scientist, the researcher, the political scientist, the engineer, and the seismologist.

Federal funds and Federal coordination are required. To me, FEMA is the right agency for this coordinated effort. However, I have been a little disappointed with its slow formation, and in taking hold of mitigation problems.

The Earthquake Hazards Reduction Act of 1977 is a good law. Within it is a little clause on the planning for the implementation. At the time I was in Washington 2 years ago, an office of 10 to 12 people was envisioned. It would have been a coordinative body among other functions, and would consider the problems of old hazardous buildings. The responsibility was given to FEMA; to this date, FEMA has not implemented the law although it has the capability to do so. I would hope in a kind and friendly way that we urge them to do what the law asked them to do.

Thank you.

Mr. **Brown**. We recognize the problem you have discussed here. In fact, we have discussed one phase of it this morning in connection with the fire administration because a similar criticism can be made. There is, of course, a larger consistency for doing something about fires, but the philosophy there still seems to be when reacting to the fire rather than planning for the mitigation of the fire hazard through a program of public education or correcting the features which can lead to destructive fires, the whole range of things that can be done.

The fundamental problem seems to be we are allergic to using our brain to think about the future and plan constructively to deal with it, as much as anything else. That is true of Congress in many ways.

Accepting the accuracy of your diagnosis of the problem over there and without trying to point the finger of blame in any way, do you think there is any way in which we could constructively encourage some movement toward the kind of program that you are hinting at here?

Professor **Steinbrugge**. I cannot. I sincerely believe that they have the right mission. I know that their people are capable and willing. I cannot speak to the trauma of reorganization which, to me as an outsider, seems to be taking too long.

Mr. **Brown**. It may seem to you that it is too long, but they really are just getting into it. They are not yet fully reorganized. They do not have all of their key people in place, and they do not have the unifying philosophy yet, I think, that is necessary in order to make for the most successful operation.

[The prepared statement of Karl V. Steinbrugge follows:]

Testimony Presented on February 28, 1980 to the
SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

on the
EARTHQUAKE HAZARDS REDUCTION ACT OF 1977

Karl V. Steinbrugge
Professor Emeritus, University of California, Berkeley

Earthquake hazards reduction has been a major interest of mine for over thirty years. In this regard, I have served on many local, regional, and state governmental panels and commissions as well as having worked with the scientific and engineering communities. This experience has included successes and failures in earthquake mitigation, both in their program content and in their implementation practices.

Today I would like to present views from my background as chairman of two major studies conducted by the Federal Government in 1970 and 1978. The first of these in 1970 for the Executive Office of the President listed the needed major earthquake hazard reduction programs and when benefits might be expected after their implementation. The second in 1978 for the Office of Science and Technology Policy in the Executive Office of the President resulted in a detailed series of statements on "Issues for an Implementation Plan." Concurrently with the latter study and with co-commitment to it, the Working Group which I chaired made every effort to begin the implementation of the Earthquake Hazards Reduction Act of 1977.

Also in 1978, FEMA was in its preliminary organizational stage and I was then led to believe that FEMA was to have become an operational entity not long after my departure from Washington, D.C. in the fall of 1978. My group was working towards Section 5(b) of the Earthquake Hazards Reduction Act of 1977 which spells out in a reasonable fashion how a coordinated earthquake hazard reduction program would be established and maintained.

FEMA's very important role in hazard reduction is unquestioned and the agency's basic objectives are excellent. However, steps taken by FEMA to date to fill this role seem weak or have been minimal in a number of important areas. Basic research and considerable applied research are being conducted by a number of other agencies. FEMA's overall role is to channel this research plus adding any necessary research to only one goal: saving lives and reducing property damage. To date, I have not seen any major FEMA efforts to reach this goal, and I strongly urge accelerated action towards this end.

In 1978 as FEMA's organizational structure began to take preliminary form, the enthusiasm in the sciences and the design professions was great, anticipating a well-directed attack on hazards. This enthusiasm has waned somewhat as a result of inaction, but we continue to remain hopeful.

Where do we go from here? What are some of the major problems and their complexities?

For one such problem, existing hazardous buildings remain the principal threat to life, possibly excluding dam failure in certain communities. Earthquakes do not directly kill people, but buildings which may collapse are the real hazard. A 100% elimination of this problem throughout the seismically active areas of the United States may not be feasible in the near future, but this is no reason for ignoring the problem nor is it a reason for not taking some actions on the most extreme hazards. Admittedly, the economic issues are so great that no single community or state government by itself can adequately resolve them in many cases. The magnitude of the problem usually warrants a joint effort, or partnership, among Federal, state, and local governments on a collaborative basis with the private sector. But far more than economic factors must be considered. Human and social factors as well as engineering and science are also interwoven. For example, San Francisco's Chinatown is a major potential death trap in a great earthquake due to the high number of collapse-hazard buildings, high population density, and narrow streets which impede rescue when debris strewn. A simplistic direct approach of condemnation and reconstruction would involve cultural problems, civic pride resistance, historic preservation problems, housing for non-English speaking refugees, as well as economic difficulties for many thousands of persons. Approaches to solving the problems in this specific instance are not clear, but this situation does not change the hazard or the needs of the inhabitants. Certainly, FEMA's role in research and hazard mitigation needs fulfillment in this particular instance. However, the hazardous building problem also exists in all major cities where a destructive earthquake can occur. Generic solutions will require the involvement of all levels of government as well as all facets of the private sector.

For a second example of a problem needing attention, land-use in geologically hazardous areas has had an uneven treatment by the Federal Government. Federal funding or Federal lands are often involved in projects concerning the "lifelines" to a city or a region. By "lifelines" is meant the pipelines (water, gas), electric transmission systems, transportation lines (highways, railroads), and other such systems. For example, it seems reasonable in siting highways and freeways which must cross earthquake active faults that major overpasses be built out of the fault zone. Federal financing of housing in structurally poor ground areas has also occurred. Certainly a stronger coordinative role by FEMA is indicated.

A total of 37 "Issues", or problem areas, was described in some detail in the previously mentioned 1978 study. Many of these "Issues" are direct FEMA responsibilities. An office comprising 10 to 12 persons is now mandatory to implement Section 5(b)(3)(E) of the Earthquake Hazards Reduction Act of 1977.

Obviously, increased funding over that which seems available will be necessary to carry out FEMA's missions in hazard reduction. Unfortunately, there is an incipient trent in government to take funds earmarked for earthquake hazard reduction and spread them over an all-natural-hazards program. This dilution, if it takes place, will reduce the effectiveness of the Earthquake Hazard Reduction Act. It would seem to be FEMA's role to monitor this possible trend.

To this point, discussion has focussed on the Federal involvement, particularly FEMA's role. But as previously stated, success requires a partnership among all levels of government and non-governmental entities. In the ultimate, success will rest with a public convinced that their dollars via taxes or other means should be committed to earthquake hazard reduction. Appended is a copy of my paper "Implementation Strategies" to be given at a forthcoming earthquake hazard reduction workshop. This paper is based on case histories of successes and failures at non-Federal levels, and the discussion may be helpful to better understand the roles of other entities in hazard reduction.

In summary and conclusion, it appears that FEMA has not yet fully taken its rightful active role in implementing the Earthquake Hazards Reduction Act of 1977, although it has the capability of doing so. It has been much too slow in staffing and funding. Major safety problems affecting hundreds of thousands of lives in hazardous old buildings as well as land-use in earthquake geologically hazardous areas are examples of attention-needing situations. It is hoped that the long overdue actions by FEMA will become visible in the near future. There have been three moderate, but damaging, earthquakes since 1977 in California. Let us not wait until the great one occurs. Due to the enormity of the problems, it is strongly recommended that the Earthquake Hazards Reduction Act of 1977 be reauthorized.

APPENDIX TO TESTIMONY
BY KARL V. STEINBRUGGE

Paper to be given at
Illinois Institute of Technology

# IMPLEMENTATION STRATEGIES

by
Karl V. Steinbrugge

"Implementation strategies" are defined for the purposes of this Workshop as strategies that relate to earthquake provisions in building codes, trade practices, union considerations, viewpoints of financial institutions, insurance as a mitigation tool, and related factors. These implementation strategies are intended for real situations where the earthquake hazard is sufficiently great to warrant changes in public policy leading to earthquake hazard reduction measures. By and large, implementation is usually left to a local governmental level (such as city and county level), although in some states it is partially or entirely at state level. Over the years, Federal inputs to local programs have been sporadic, minimal, and inconsistent, both with respect to the Federal's own construction programs throughout the nation and to non-Federal construction financed by the Federal Government. It is therefore appropriate to distinguish between the roles of local (and state governments) and Federal.

## Local and State Strategies

How can one best develop needed implementation strategies when the hazard is real? Many human factors enter into the scene where the public and public policy are concerned, and solutions require a knowledge of these factors. It seems instructive to examine the case history of the implementation of earthquake resistive design west of the Rocky Mountains. (It is difficult to use the word "strategies" in the context of history since there were none.)

The great San Francisco earthquake of 1906 found the public, government, and academia totally unprepared for the event as well as response after the event. Professor Andrew C. Lawson writing five years after the event wrote these comments:

> ".....In the present state of public opinion in California for example, it is practically impossible to secure state aid for the study of earthquakes. The commercial spirit of the people fears any discussion of earthquakes for the same reason as it taboos any mention of an occurrence of the plague in the city of San Francisco. It believes that such discussion will advertise California as an earthquake region and so hurt business....." (*Bull. Seism. Soc. Am.*, 1:3, 1911)

The San Francisco building code was strengthened after the 1906 event by increasing wind force design requirements, but these wind requirements were reduced over the next few years "since San Francisco does not experience major windstorms." In 1906, the technology of earthquake engineering did not exist and the science of seismology was in its infancy; perhaps it is little wonder that the public tried to forget the event since there were no solutions for coping with the problem.

About two decades later, the 1925 Santa Barbara, California earthquake gave impetus to the first United States earthquake provisions in building codes, namely the 1927 UBC and the 1928 Chamber of Commerce codes. Although the proposed code provisions were crude and were essentially not adopted by jurisdiction, these code showed that significant segments of the engineering and scientific communities felt that they could produce effective earthquake resistive construction. However, the building industry was not fully convinced as may be seen in their published literature on the 1925 Santa Barbara earthquake. It has often been noted that public decision-makers (city council persons, state legislators, etc.) take little or no action when the experts are divided in their opinions, and the building industry are experts in costs and construction. Thus, implementation of hazard reduction measures after 1925 was minimal. No overall implementation strategy had yet evolved.

Prior to the 1933 Long Beach, California earthquake, public opinion in the Los Angeles metropolitan area (including Long Beach and many other cities) was undoubtedly swayed by a book authored by a prominent geologist and published by the Southern California Academy of Sciences in 1928; one conclusion was "The accumulative weight of data substantiates beyond a doubt my deduction that Los Angeles is in no danger of a great earthquake disaster." The 1933 Long Beach disaster brought the debate to a close. Strong earthquake provisions were added to metropolitan Los Angeles codes and these are strongly enforced to this day. Additionally, public school construction was pre-empted by California State law and the Field Act remains as an excellent example of good implementation of public policy.

California's Hospital Act was passed in 1972 as another special purpose law, being based on the concepts of the previously mentioned Field Act. The occasion for this legislation was the near-collapse of the Olive View Hospital and the collapse of the Veterans Hospital in the 1971 San Fernando earthquake. At that time, the then Advisory Groups to the California Legislature's Joint Committee on Seismic Safety became an effective focal point for marshalling the knowledge of the researcher, design professional, and others to a concerned legislature and to a concerned public.

The Field Act and the Hospital Act are examples of special purpose laws which, if carefully written immediately after the event by persons who did not over- or under-react, can withstand the passage of time. This is not to say that public reaction does not eventually set in; the Field Act has had to be defended regularily and was almost eliminated on several occasions. Thus, one must be reasonable when, in the immediate post-disaster period, the legislature and the public may be in a mood to accept ill-conceived or unduly restrictive measures. Pre-planned legislation by seismically concerned organizations is a reasonable implementation strategy.

Success is not automatic. Current land-use of Anchorage's 1964 earthquake induced landslide areas may be cited as examples. The unstabilized landslide areas have varying degrees of hazard according to the large majority of knowledgable technical persons. Also, these areas are well-known and well-established, having been published on USGS maps and in reports by others. The public has been kept aware through frequent mention in the press in recent years. But after the 1964 Alaskan earthquake, local government did not obtain title to the "worthless" landslide property in Turnagain and allowed owners to continue to pay taxes on their landslide property. Now, 16 years later with fading memories and with a large influx of new people, new construction is beginning to appear in the most spectacular of the landslide hazard areas (Turnagain). A deeply divided local government currently (1979) appears to allow development in this area.

Case history to this point shows that earthquake hazard reduction measures are accepted by the public when the researcher, the design professionals, and the construction industry believe in the hazard, make a good and reasonable case, take their case to the public in a convincing manner, *and* a disasterous event occurs or has just occurred. But, clearly, proposed hazard reduction measures to be taken long after an earthquake and *before* the next event are another matter. It can be done, but it takes time. It was the late 1940's before the public and local governments in metropolitan San Francisco area were willing to adopt appropriate code measures. Since then, earthquake bracing is required and implemented in hundreds of California cities, many of which have never experienced a damaging earthquake.

Many other examples may be cited, but that of Salt Lake City is perhaps of particular interest. Their case history began when the well-respected U.S. Geological Survey geologist, Grove Karl Gilbert, wrote to the "Salt Lake City Tribune" in September of 1883, stating in that regard: ".....I was led to sound a note of warning in Salt Lake City....." ("Lake Bonneville", U.S.G.S. Monograph, Vol. 1, 1890, page 362).

There have been no major earthquakes in Utah in historic times, and no significantly damaging ones in historic times in Salt Lake City. Salt Lake City is far from San Francisco and Los Angeles, and the "domino effect" would not be great in respect to convincing those involved in decision making. But the evidence on which Gilbert raised his warning is as valid today as then. The present writer well remembers his trips to Salt Lake City in the 1950's and 1960's to inspect the geologically active Wasatch Fault which cuts through the city and his trying to convince the local public of the hazard -- all to little avail. But, over the years, *local* academia and *local* design professionals became increasingly convinced of the hazard and vocal. Concurrently and subsequently, the larger contractors having worked in Californi and elsewhere on earthquake resistive projects, dropped or reduced their opposition to earthquake resistive codes as they understood both the hazard and that cost increases were tolerable and fair. National corporations having facilities in California were not adverse to earthquake design. Financial institutions played no significant role. Earthquake resistive design is now required and practiced in Salt Lake City, although admittedly not with 100% support by all elements of the community.

The Salt Lake City example is not unique. Reno, Las Vegas, Portland (Oregon), Albuquerque (New Mexico), and other cities west of the Rocky Mountains have implemented earthquake hazard reduction measures to one degree or another, and in each case without having a major destructive earthquake during recorded history.

The Salt Lake City example shows that, if the hazard is real and if the researcher, design professional, and construction industry largely agree on the hazard, then the public will accept hazard reduction measures. This is a simple statement of the implementation strategy in areas west of the Rocky Mountains. One caveat remains: the foregoing applies to new construction, while retroactive measures bring in philosophical disputes having an overtone of "statute of limitations" and perhaps insurmountable economic and cultural problems.

## East of the Rocky Mountains

A new dimension is added to implementation strategies for areas east of the Rocky Mountains, namely the recurrence interval is generally much greater and the public thereby perceives a hazard too small to be of concern. Understandably and correctly, public acceptance of proposed implementation measures will be much more difficult before a damaging event. In many cases, it may well be that a cost-benefit study will dictate for most of these areas east of the Rocky Mountains that good public policy should be limited to aid and redevelopment *after* the event. (However, after the event, public opinion normally reverses due to a life loss "that is inexcusable.")

Alternately, an additional step to the implementation strategies may well be appropriate in these areas, namely, the interrelationships which exist between other natural hazards and earthquake resistive design and construction. This thought is not new and has twice been part of reports which this writer chaired for the Executive Office of the President:

> ".....For those areas which might be considered almost exempt from earthquake hazard, earthquake resistive construction usually develops a facility which is also more resistant to unprecedented wind storm, explosion, and fire as well as certain geological hazards....." (Earthquake Hazard Reduction, Office of Science and Technology, Executive Office of the President, 1970, page 8.)

> ".....The program will be more readily accepted nationwide if key decisionmakers and the public perceive that it will also provide protection against other types of hazards. Similarily, measures to reduce hazards could mutually benefit from "piggybacking" on each other's programs and operations. As a matter of fact, in some parts of the Nation, effective measures to mitigate earthquake hazards will be feasible only as part of an overall program to reduce hazards (such as, floods, windstorms, and landslides) ....." (Earthquake Hazards Reduction: Issues for an Implementation Plan, Office of Science and Technology Policy, Executive Office of the President, 1978, page 13.)

A new caveat applies to this multihazard approach where applicable. Let us accomplish this goal east of the Rockies by obtaining additional research funds and not by reprogramming earthquake funds which are simply insufficient for multihazards.

Even if researchers feel that the earthquake hazard is high, implementation of strategies east of the Rocky Mountains is not assured in the near term. Significant skepticism exists among large segments of the design professions and in the construction industry, including those associated with unit masonry. Hopefully, it will not require the loss of thousands of lives to bring about the implementation of earthquake hazard reduction measures.

## Special Topics

### Financial Institutions:

Brief mention should be made of the limited impact of financial institutions, including banks and insurance. Studies focusing on the use of these institutions as mitigation tools show that these organizations have not been effective due to a variety of reasons. Anti-trust fears arise when collective uniform enforcement of common standards are proposed. Rate/interest differentials have in the past proven insufficient to inhibit construction in fault zones and landslide zones. Competitive pressures are real (since earthquake insurance, for example, is voluntary, the interested party may go elsewhere or drop the coverage). A further discussion may be found in "Earthquake Hazard Reduction: Issues for an Implementation Plan," Office of Science and Technology Policy, Executive Office of the President, 1978. Economic limitations are discussed in Earthquake Insurance and Microzonation in "Proceedings of Second International Conference on Microzonation," I:203/213 (1978).

### Unions:

Significant opposition to change inevitably arises when job security is involved. This is understandable and supportable, and is in an area where the scientist/engineer is often accused of being insensitive.

Turning again to California experience, unreinforced unit masonry with sand-lime mortar has always suffered the greatest earthquake damage in major shocks. The 1933 Long Beach earthquake provided the climax, resulting in the virtual eclipse of unit masonry construction. This, of course, equally affected the employers (brick manufacturers and masonry contractors) and employees (union members).

In time, labor and management in the unit masonry industry under the leadership of a foresighted person undertook a labor-management sponsored research effort which was successful in convincing the design professionals that reinforced unit masonry could be economically and safely built. In one form or another, this new technology is commonly found west of the Rocky Mountains. It costs more, but the costs are tolerable.

Can this technology be transferred elsewhere in the United States? Should it be transferred? If so, how and by whom?

Federal Government:

As has been stated, the Federal role has been usually minimal in any direct sense. For an action program:

> The Federal Government should begin by instituting more effective measures in its own facilities and by coordinating its own programs to reduce hazards, thereby setting an example and developing a set of standards for others to emulate.
>
> If the Federal Government does not practice what it preaches to States and localities, the program's chances of success will be greatly diminished. (Earthquake Hazards Reduction: Issues for an Implementation Plan, ibid, page 12.)

## Conclusions

Successful implementation strategies have evolved west of the Rocky Mountains that require the existence of a real hazard as the public views it. This, in turn, requires the vocal and other strong support by convinced researchers, design professionals, and construction industry before the public decision makers will also support the position -- normally local and state governments. The process of obtaining change under non-catastrophe conditions is generally through small increments.

East of the Rocky Mountains where recurrence intervals are greater, a multihazard approach on a broader financial support basis is indicated.

A caveat exists, the foregoing has reasonable chances for success for new construction, but not for retroactive measures despite apparent great need.

**[The biographical sketch of Mr. Rigney follows:]**

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## BIOGRAPHICAL SKETCH

ROBERT B. RIGNEY, Administrator
Environmental Improvement Agency
San Bernardino County
(Including the Following Departments)

Air Pollution Control District
Building and Safety
Environmental Analysis
Exper. Housing Allowance Program
Special Districts
    Water
    Sanitation
    Fire
    T.V. Translator
    Parks & Recreation
    Street Lighting
    Local Roads

Environmental Protection
Community Development & Housing
Environmental Health Services
Local Agency Formation Commission
Fish and Game Commission
Forestry, Fire Warden
Planning Department

## STATE AND REGIONAL GOVERNMENTAL OFFICES

1. California Seismic Safety Commission - appointed by Governor Brown, 1975, and by Senate; Vice-Chairman, 1976-77; Chairman, 1977-79.

2. Southern California Association of Governments: Environmental Quality Committee, 1975-76; Red Tape Task Force Committee, 1975-76.

3. Senate/Assembly Committee on Seismic Safety - appointed by Senate, 1971.

4. Senate/Assembly Committee - Vice-Chairman, Governmental Organization and Performance, 1972.

5. Blue Ribbon County Charter Review Committee - Executive Officer.

6. Office of Science and Technology Policy, Group on Earthquake Hazards, Office of the President - Advisor, 1977-78.

7. U.S. Construction Specialists Exchange Tour to People's Republic of China, October 1978, Chairman. "Los Asentamientos Humanos En La Falla De San Andres", Chairman, U.S. Mexico Symposium. Western States Seismic Policy Council, Chairman, 1979.

## PROFESSIONAL MEMBERSHIPS AND OFFICES

National Association of County Officers - Charter Member
Member, Committee on Natural Resources and Environmental Administration, American
    Society for Public Administration
California Association of Local Agency Formation Commission, Legislative Committee
Association of Environmental Professionals - Board of Directors and Founding Member
    representing San Bernardino, Inyo, Mono, Riverside, and Imperial Counties
American Society of Public Administration
Earthquake Engineering Research Institute, Member

## AWARDS

U.S.A. National Achievement Awards, National Association of Counties (NACo) for:

Comprehensive Air Pollution Program/New Analytical Method for Nitrogen Oxides
Carbon Monoxide and Hydrocarbons Industrial Monitoring
Air Quality Management Plan
Environmental Review: Program for Implementation
Environmental Enforcement, A Centralized Complaint Response Center
Food Industry Retail Services Training Program (FIRST)
Sanitarian Training Program
Environmental Quality Indicators
Matching Manpower to Work Load for Planchecking and Building Inspection
Roof Rats - Control through Environmental Change
Fire Alert Programs
Environmental Decisions through Geoprocessing
Home Repair for Senior Citizens
Streamlining Planning Programs Redesign
Litter Control Program
Low Cost Housing Program
Airport Land-Use Plans
Land Development Services
County Planned Development: A Comprehensive Partnership Approach to the Planning,
    Development and Financing of an Unincorporated City

## PAPERS AND PUBLICATIONS

"The First 500" - Analysis of Local Agency Formation Commission actions and review of
    similar programs in other states.
"LAFC - Survey of Terms and Conditions"
"Opportunities, Problems and Landmark Decisions of the San Bernar[illegible] County Local
    Agency Formation Commission"
"Incorporation Procedures for California Cities with Particular Reference on San
    Bernardino County"
"Proposals and Thoughts Relating to a State Earthquake Commission Based on Regional
    Principal"
"China: Snapshots or Impressions of Seismic Programs"
"The California Seismic Safety Commission - Its History, Accomplishments, and Future"
"Impact of Natural Disaster Planning (Earthquake, Floods, and Fire) in Land Use
    Planning and Local Building Standards"

## STATEMENT OF ROBERT B. RIGNEY, ENVIRONMENT IMPROVEMENT AGENCY

Mr. RIGNEY. Thank you, Mr. Chairman.

I know there is no need to describe our county to you because certainly you recognize it and know it as well as I do. For those who are not aware of Western counties, however, we like to talk to our Eastern brethren and say, "Well, in your State you can do it because you are so small, but you can't in our county because it is so much larger," and that is because, as you know, we are as large as Massachusetts, New Hampshire, Rhode Island, and Delaware combined.

Mr. BROWN. I do not believe it.

Mr. RIGNEY. We tried to measure that once, and we have prepared maps overlapping those States to illustrate it.

But I will say that that is sort of a false statement. We wave the banners of size and the banners of self-rules as the most fervent chamber of commerce president would do, but we know that in reality you, the Federal Government, almost own us lock, stock and barrel.

You look at all of that land and over 80 percent of it is owned by the Federal Government either in the U.S. Forest Service, the Bureau of Land Management, the big military bases, and other Federal areas.

In addition, you give us most of our dollars. We have a $450 million budget, but only 12 to 14 percent of that is raised by property taxes, despite all of the furor of proposition 13. The rest of it comes from sales tax and fines, fees and forfeitures and State and Federal grants. So you are really our partner, our silent partner really, because most often—we do a lot of talking about filling out forms, and following procedures, but we seldom get a chance like this to talk about policy statements, and we appreciate it.

In our particular area, disaster mitigation efforts are handled through the country and its various departments, through about 16 cities and through a multitude of special districts, although most people in the Federal and State government do not recognize that much of our government and services are handled through them. Therefore, one cannot refer to a local government as a monolithic type organization, but must be recognized that it has many separate organizations that have an impact on hazard mitigation, such as fire districts, water districts, sanitation districts, TV translator districts, even cemetery districts. All of them have a part of the program.

I might say that in our county we have 70 of these districts and 112 board governed districts. To organize all of them is a major problem. It is like running the U.S. Congress as a committee of the whole on all of the programs. How we are going to handle them is one of the things we are going to talk about today.

Obviously, we need coordination and integration of our hazard mitigation programs. We have recently had a flood which you read about. We have had fires in the summer and a multitude of small earthquakes. They do affect each other, and we need to integrate the management of them.

Fortunately, however, we have leadership coming forward that is recognizing that we need this type of hazard mitigation. The local newspaper this week indicated that certainly those persons whose property has been damaged will need help in restoration, but it would be utmost folly for government spending patterns to be used in a way to encourage people to rebuild and stay in disaster prone areas without concurrently attempting to diminish the forces that cause the disasters.

That is a heartening statement. A lot of leaders say the same thing but on the actual nitty-gritty operating level, there is still a lot of argument: Shall we use tax incentives to help mitigate disasters when those very tax incentives reduce the operational revenues for the flood districts and the fire districts and those types of districts offering mitigation services?

Is it more effective to strengthen all of the homes in the San Andreas Fault area where we live, or is it more effective to identify the fault and build only houses in critical areas to higher standards?

Should we use construction standards to mitigate earthquake problems? Do good construction standards for fire prevention make the buildings vulnerable to earthquakes?

Again, we need coordination.

What are the major problems? No. 1, I would like to emphasize leadership and incentives. It is difficult to sustain leadership, as a number of people have pointed out today, particularly when you are building for a disaster which comes every 20 or 30 or 160 years. It is easy to ride in on your white horse when one is going to bring in money and in a few weeks straighten out a problem of current damage with outside dollars, but when one has to pay for something that will not pay off for 20 years—it is hard to get elected officials to put their time in for those kinds of programs. We need something to get this kind of leadership before us, and to sustain it because those leaders need help.

They need tax incentives and insurance programs they can talk about. They need effective recognition by other levels of government. FEMA could have helped us this time in the last flood program, and we missed a bet here because they did come in with their team with high visibility to explain to the people in a coordinated way the services that they had to offer. Such people are always proud of their services, but it would probably have been better—although they are accustomed to operating at the middle manager level approach where most of these types of programs are evolved—if they had come in in a frontal attack and met with the top leaders. Instead of saying, "Look, we are coming from Washington to help you," they would be more welcomed and appreciated by local government if they said, "Hey, we've got these services; why don't you go out into the community and say look, we had the political clout to get these people in from Washington to help you; here they are; make use of them."

Local leaders would have felt good, a part of the team, knowing what they were supposed to do, and there would have been a mutually supportive process. It was a good program, but I think with a bit more experience, we could make it better.

We also need to know what are the natural geographical areas of coordination. Until you talk to people in our desert communities you do not know that there are invisible lines which people draw around themselves containing community pride and activities. The people know where those areas are.

They may correspond to political jurisdictions, and they may not. We need to harness the power in those logical areas which bring people together to help each other. We need to recognize those boundaries and work with them to harness that energy and, in addition, map them with overlapping safety or hazard mitigation areas so we work together on coordinated programs.

We need to know the various levels of decisionmaking of local government, and recognizing that it is fragmented. The same is true with the Federal Government. We have many different agencies with many different roles, and often local government roles are the people who get the Federal agencies to talk with each other. We have to recognize there is that kind of fragmentation and work with it.

We talk about affordable priorities, and our social scientists who previously testified indicate that they felt there was an unholy alliance, against us and I know there is. But at the same time, I would like to point out there are holy alliances that work against us, too.

When we talk about affordable housing, we are talking about those same houses that are hazardous in natural disaster. I cannot do anything to eliminate those houses because they are also extremely important for housing and if I price or regulate them out of existence, I cannot do it without supplying additional housing. These other priorities have to be recognized.

I was interested in the testimony today on the insurance community because both the banks and the insurance companies can be big allies of Government in effective hazard mitigation. We seldom talk to each other along lines, and it is very difficult at the present time for both of them to recognize what great powers they have in a community to either support hazard mitigation on appropriate land use policies, or break them by their financing and insurance policies. And they should be, I think, a positive role and an ally working on a coordinated problem for the benefit of both Government and private sector.

We also need additional financial mechanisms to finance special projects even though we seem determined to vote the use of such mechanisms out of existence in California.

How can we increase the possibility of effectively designed and implementation programs for hazard mitigation in the future? Well, I think first of all we do need pilot programs to actually show what does happen during the time of a disaster We have a flood disaster right now and I am responsible for parts of the disaster response program.

I was happy to see—I thought it was a good program—to see State firemen which the county pays under a contractual relationship putting out food for volunteer workers which were accumulated by the city, working on flood control district problems within the city. What a great example of intergovernmental coordination.

But I knew as a good bureaucrat that sooner or later somebody who had to pay for all of that, and the person who pays for it is the one who authorizes it—so I said, "Hey, who gave the orders for that? That is great."

Nobody gave the orders for it. Nobody was responsible for it. I would like to have taken credit for it. It just happened. How did it happen? Nobody knows yet, or at least they will not admit to it. But I did hear one elected county representative say, "You know, that mayor of that city can talk the socks off of anyone," and maybe in reality personalities transcend plans at those particular times, and you have to recognize that, and your plans have to be flexible.

But if one could set up a pilot program, look at some of the smaller disasters and project them into the future, it might be of great value to look and determine how loose or how tight—and I have a sneaking suspicion we probably need pretty loosely designed hazard mitigation plans and disaster models—to know our plans and to find out what are the most successful hazard mitigation techniques, the most successful organizational characteristics, and the best public information and information programs, and so forth.

Just because we have an earthquake and people are killed does not mean, for instance, that buildings are not designed properly. It may well mean that bookcases fell over or something else happened. We really have to know the reasons for the deaths in those cases. We ought to know what the role of the various governmental entities is, in addition to the private sectors and the universities. In our area, I think universities are a neglected resource. We seldom use them, and they should use us as laboratories in which they can experiment or observe.

We would like to know whether our best mitigating measures are self-imposed. We need risk analyses. We need cost-effective mitigation measures. All of these things can be done. The program should be overseen by a blue ribbon committee of prominent citizens which we recognize, give proper appreciation and keep them up front with all of the certificates, recognition dinners and other programs to give them and the project visibility.

It was Napoleon who said he conquered Europe with the ribbon of the Legion of Honor. I think we can still use those techniques to keep this program up front and constantly before us.

A second program I would like to look into is a pilot program for recordkeeping for hazard management. We have tried in the past in the State legislature to get known disaster areas recorded on deeds. In other words, if you are in a flood plain area, that should be recorded on your deed so when you have your title insurance policy you know of your potential problems. We have met with resounding failures on these proposals in State legislature.

People do not like that information recorded. We have tried a different approach, and we have kept all of this information in big piles of maps and documents in one governmental office. It is too cumbersome to go through to be effective.

We have a third proposal, and that is to computerize all of the parcels in the county and put on them all of the basic land information, assessed valuation, size and ownership information and also whether they are in an earthquake zone, a flood plan area, or other hazard area. It is of value now to developers, and they are supporting the program because it helps them plan around these problems.

We hope the public themselves can come in and use the information and evaluate their own properties or what they might buy. We think it is of value, but whether it will be of value after it goes out of the developers' hands and into the public's hands, we do not know.

I will go to some of the Federal actions which could be of value to us. One is the independent review of the safety standards and hazard mitigation programs on major Federal projects by the appropriate State or local agencies. Auburn Dam is a good example of that.

Should we have a requirement that Federal funds used for building purposes by State and local governments not be used until the project has addressed and identified natural hazards and planned for them in different areas? I think it would be worthwhile.

Another possibility is the adoption of Federal standards for federally constructed projects on Federal land, and FEMA is doing that at the present time, with the provisions that these standards be used unless State standards are higher.

And then perhaps the adoption of standards for interstate pipelines of water, power and transportation that may affect a local area if there is a major outage or shortage because of disaster should be of Federal concern.

One other and last comment was to suggested changes in the Federal earthquake hazard reduction program. We believe that it is improving. FEMA is taking a difficult way of reorganizing based on their original organization role. I know from experience that when you bring big blocks of existing agencies together it is a very formalized mating dance that they go through before they get organized. It is easier to sometimes break up the basic units and reconstitute them. But this is the way they are going, and I do think they are getting organized and their visibility is coming up.

We have seen them in emergency preparedness programs which involve the evacuation of people from Los Angeles. They have begun to develop seismic resistent design standards for Federal construction projects. They have included some local people in the evaluation or ranking of proposed research projects, but there is one thread of concern as voiced by the report from the Western States Seismic Policy Council, by the California Seismic Safety Commission, and by various local governments. It is for a far more effective way to become a part of an applied research program that focuses on the needs and problems of local government with the research providing alternative solutions. Local government does not wish to become part of a basic research program and leave that to the expertise of others.

It is recognized that there are pioneering approaches in various universities to bring users and researchers together, but it is generally to parade the research before the local government officials in the hopes that they can use it. The emphasis in this type of research in problem solving should be on the problem with some mechanism to obtain a wider support for a local government consensus of opinion that the problem is important enough to send to a research group for consideration and acceptance by a qualified researcher.

An alternative program would be to give local governments certain credits, points or dollars which they could allocate to buy or authorize specific research programs. Local government might also have an overview or a monitoring of the progress of the research so that they have a vested interest in it, and would be more able and ready to use it when it is finally apparent in a finished form.

I think this subcommittee needs to be a part of it, and I have suggested this to my academic friends. What you people need is a food stamp program for research people. You give local government food

best copy available

stamp program for research people. You give local government food—research—stamps or we will buy them at half price. Maybe I will have to trade with my local, academic or governmental neighbors to get enough of them, or use some other mechanism until we accumulate enough and buy or turn them in for the type of resource we actually need. Then have an automatic oversight by local governments as they would have a vested interest in the research, and will be likely to use it when it comes out.

If FEMA can further be a part of that partnership and force a partnership among local governments by bringing them together to decide what is important for research, then monitoring it through to its conclusion, this applied research should be immediately beneficial to all concerned.

[The prepared statement of Mr. Robert B. Rigney is as follows:]

# THE DESIGN AND IMPLEMENTATION OF A HAZARD REDUCTION PROGRAM

Presented to the Subcommittee
On Science, Research & Technology

BY:

ROBERT B. RIGNEY

ADMINISTATOR

San Bernardino County Evironmental Agency

## INTRODUCTION

Gentlemen, I am pleased to be able to testify before you today on a topic of major interest and importance to San Bernardino County.

To put our interest into its appropriate context, let me briefly describe our County and the organization which I represent. San Bernardino County is one of the largest counties in the United States in excess of 20,000 square miles, larger than Massachusettes, New Hampshire, Rhode Island, and Delaware combined. Its size alone gives it difficult problems of coordination, communication and cooperation which is further enhanced by the splitting of the County into three distinct units--a metropolitan and agricultural valley area, a mountain resort area, and a desert area bounded by the Colorado River. It has a wide accumulation of natural and man-made hazards with broad flood-plains currently inundated by one of our periodic floods, watershed and forest fire hazard areas, areas of landslides and mudflows and long stretches of the San Jacinto and San Andreas Fault lines. The large relatively isolated County lends itself to deliberate spills or dumping of unknown chemicals and toxic substances and the freeways and rural roads through the area have provided a setting for accidental spills of toxic materials which is one of the current leading disaster problems in the County. The airports, military bases, major chemical plants, steel plants, fuel transmission lines, and power plants all have their special disaster problems when seen in their relation to our natural hazards.

Disaster mitigation efforts are handled through the County offices and 17 cities providing typical disaster services, land use planning and enforcement of construction standards. In addition 112 board-governed and 70 self-governed districts of varying sizes, from a few blocks in size to 200 square miles or more in size, provide a wide-range of fire, hospital, water, sanitation, T.V. translator communication and other basic services to the incorporated and unincorporated areas of the County.

Added to the traditional councilmen for each city, supervisors for the County and their related appointed officials, there are over 900 commissioners and a multitude of appointed district offices all involved in major and minor hazard mitigation programs.

The coordination needs are obvious. To try to coordinate a number of programs at the County level, the Board of Supervisors has consolidated related services into major agencies. The Environmental Improvement Agency of which I am the Administrator includes the Land Use Planning Agency, which can mitigate hazards by appropriate land use controls and directions; the Air Pollution Control District in the desert area; the Building and Safety Department which enforces the construction standards of the County; the Community Development and Housing Department, which promotes the rehabilitation of existing facilities and the building of affordable housing; the Environmental Health Department, which sets standards for water, sanitation, food supplies, vectors, and other necessary standards for use in disaster and normal times; the Special Districts Department, which for the Board of Supervisors governed districts provides fire protection, water lines, sewer lines, communication programs, T.V. translators, and works with the Board-governed districts which may provide hospital protection, wholesale water lines; and the Local Agency Formation Commission, which sets the boundaries and service area lines for current services and projected services.

## PURPOSE OF THE TESTIMONY

My invitation was to testify on the following points:

1. Major problems for local government in the design and implementation of natural hazard mitigation programs.

2. Suggested approaches in designing and implementing natural hazard reduction programs.

3. Suggested changes in the Federal Earthquake Hazard Reduction Program.

## NEED FOR AN INTEGRATED MANAGEMENT PROGRAM FOR HAZARD MITIGATION

Our recent flood from which we are recovering, the fires of the summer and the constant tremors of the land from the recent small earthquakes of the 5.0 range have kept us well aware of the need for an integrated management program for hazard mitigation. Even while government is caught up with the problems of rebuilding after our recent floods, the local newspaper, the San Bernardino Sun, represented many of the community leaders in their lead editorial of February 24, 1980, stating that they hoped that the local governmental agencies will have the fortitude to insist that the bulk of available money will go to basic projects that can prevent or greatly minimize future disasters, and they highlight the following paragraph with italics.

> *"Certainly those persons whose property has been damaged will need help and restoration; but it would be utmost folly for governmental spending patterns to be used in a way to encourage people to rebuild and stay in disaster prone areas without concurrently attempting to diminish the forces that cause the disasters."*

Those general comments are heartening, but the need for integration is even more apparent when one listens to the practicioners of public administration. Are tax incentives to reduce hazards effective if the very nature of them were to reduce the operating tax revenues of the fire districts, flood districts, and other district mitigation service?

Is it more effective to strengthen all of the homes against general ground shaking through higher building standards in the general San Andreas Fault area or is it more effective to identify the fault and build to higher standards for that specific area.

Is it better to reduce hazards from earthquakes by higher construction standards or higher land use planning standards or a combination of both?

Do good construction standards for fire prevention make the building vulnerable to damage by earthquakes has been pointed out by some of our building officials following inspections of the hospital after the San Fernando earthquake. Intergration, coordination, and a final determination of effective hazard mitigation techniques are most urgently needed.

## WHAT ARE THE MAJOR PROBLEMS OF HAZARD REDUCTION DESIGN AND IMPLEMENTATION PROGRAMS INVOLVING DIFFERENT MUNICIPALITIES AND A DIFFERENT NATURAL HAZARDS?

### Leadership and Incentive

Recognition of the problem and leadership in resolving it is probably the number one factor in a good hazard reduction program. Such leadership is not easily come by for it promises no immediate reward.

The person who provides help and money in the clearance of debris after a major disaster rides into the scene on the traditional white stallion and is the hero of the moment. The man who is working with hazard reduction and who may not see its value in his political lifetime is riding a sturdy plow horse, and though his furrows may be long and straight his harvest may not be for many years.

For an elected leader to devote an agency's resources to hazard mitigation when he must stand for an election every two or four years, is a difficult choice of priorities when the disaster against which he may be working occurs in 50, 100 or 160 year cycles. That this committee is having hearings on this problem today and that we are as effective as we are, is a tribute to the statesmen-like qualities of the people who have led our communities and nation for the past years. However, various incentives can help to produce that leadership and sustain it through the years. Tax incentives, insurance programs, effective research aimed at the smaller community, recognition of individuals by a higher level of government, can give help and effective tools to the incipient leader. Recognition is important and Napoleon often gave credit for the ribbon of the Legion of Honor for his victories and his lessons might be noted in wars against disaster.

## APPROPRIATE GEOGRAPHICAL AREAS OF COORDINATION OR INTEGRATION

An integrated disaster management program has to recognize the right geographical areas for effective coordination and integration. Perhaps there is a territorial imperative that places people in specific communities where it is recognized that they support and help each other. Certainly in our County it is known that those vast expanses of desert and mountain land do contain invisible boundary lines which unite people to certain common centers for help and protection. For whatever reason these feelings of local pride and community identity must be recognized harnessed and capitalized upon for an effective use of their resources.

There are practical reasons for delineating areas of coordination that may or may not match political boundary lines. Areas of communication and dispatching services must be recognized which are not blocked by mountains or distance. Response time, resource centers, transportation routes, and existing organizational patterns must be recognized in setting these areas for disaster management. Familiarity with operating personnel and their operational techniques is needed.

This week our County is holding hearings on our Land Use Development Code which sets up safety zones for land use planning, recognizing special needs and mitigation efforts which may be needed to overcome recognized potential natural hazard disaster areas. This type of a boundary in conjunction with community identity boundaries might also be utilized to integrate total disaster programs into logical units.

## APPROPRIATE INVOLVEMENT OF LOCAL AND FEDERAL GOVERNMENTS WITH RECOGNITION OF THEIR DIFFERENT CAPABILITIES AND RESPONSIBILITIES

Most of the literature indicates that Federal and State governments may be the stimulating, financing and general coordinating agencies of major disasters, but the local governments must be the implementing agency. This makes some sort of a basic assumption that local governments are the same and have the same capabilities, resources and powers. This is far from true, as apparent in our own County. Certainly land use powers and the enforcement of building standards generally are the responsibility of the cities and counties. However, critical services needed in times of disaster such as water, sanitation, fire protection, hospitals, are in the hands of approximately 160 special districts, none of which have enforcement powers for building and safety standards, or have very limited enforcement powers. In additions, it should be recognized that with a few exceptions their facilities are not required to be built to the standards that are required for private structures, although some of the districts do have their facilities checked for compliance with building and safety regulations as a matter of caution. Some of these districts are single-purpose such as fire districts or water districts, and they do not need to coordinate their services or priorities for the expenditures of monies. Some of them are multipurpose and have the power to coordinate programs and set priorities. To keep track of them and their leaders through card catalogs is a major problem, much less effectively organize them. They must be broken down into logical subunits but linked to each other by training and mock exercise. They do need training in recognition of each other's patterns of operation, practice drills, a certain standardization of equipment coordinated education and information programs and other programs to make them effective. This coordinated training can be provided at higher levels of service such as State or Federal government, or with more difficulty, through joint powers association made up of different local districts bound together by contracts.

## APPROPRIATE PRIORITIES

Disaster appropriations receive high priorities during times of disaster, but they lack a forceful sustained popular constituency during the times between disaster. Some long-range programs need to be devised for organization, finances or activities that will keep disaster mitigation measures and disaster planning at a reasonably high level of visibility and action during the times between disasters.

## APPROPRIATE APPLIED RESEARCH

Much research has been done in the field of disaster, the understanding of disasters, and some work in the mitigation of disasters. Some efforts are made such as those of the University of Colorado to join the users of research with those who produce it. There has to be a stronger focus, however, on applied research that is initiated by local governments in response to local needs so it can be effectively used. To make it more effective, there should be mechanisms to force the local jurisidictions to come together to determine their priority of research needs with authority and resource to solicit interested reseachers to study their problems when a number of local agencies are following, promoting, monitoring and utilizing the necessary research, it will be used.

## EDUCATION AND BEHAVIORAL MODIFICATION

Education of adults and children in methods to react to disasters and mitigate them in advance in the homes and in the places of work are of major importance to any sound plan. As various disasters hit the headlines, they become the focal point for disaster training, but a coordinated approach is seldom used. Currently schools emphasize fire drills, but there should be some consistent pattern to meet the various needs of a school or any other institution depending upon instant reaction for the preservation of life and property.

Programs of keeping information for disaster response constantly before the public such as the printing of disaster procedures in the local telephone books as has recently been accomplished in portions of California has been effective. Disaster drills in the Bay area in celebration of the 1906 earthquake has been effective, and there needs to be similar innovative ways of getting information to the public.

## APPROPRIATE ROLE FOR FINANCIAL AND INSURANCE COMMUNITIES

The financial and insurance communities are potentially the most powerful forces in mitigating and reducing hazards and are seldom utilized by local governments. If banks do not finance in high hazards area or require or support government sponsored mitigation measures for their buildings, it might go a long ways toward preventing hazards from appearing that might later need Federal funds to mitigate. In talking with the local leaders, they indicate they protect their investments by appropriate insurance, and the insurance people indicate their risks are spread on such a wide basis that the individual hazard areas cannot affect them at the present time, other than through programs mandated by certain Federal or State laws. Sometimes we have seen our financial institutions encourage building in inappropriate places by putting their own banks in hazardous areas in misguided zeal to demonstrate faith and confidence in the community. These are difficult forces for local government to withstand.

While local government should continue to work in conjunction with these institutions, because of their power of required or national nature, effective interaction will probably only be at the State or Federal level or through interaction with major cities.

## GOVERNMENTAL FINANCIAL MECHANISMS

Government does need not only the finances but the mechanisms to offer the people to raise monies to resolve their problems. It is not enough to identify problems for the general public, but a method of solving and financing them must also be offered at the same time. Therefore, government does need to be able to use its traditional money raising mechanisms which provides streets, water systems, sewer systems, etc., to reduce or mitigate hazards even if they appear on private properties. Assessment act proceedings, nonprofit corporations, special district bond elections redevelopment agencies are all needed to raise money for the resolution of local problems to benefit local people. The current direction in California seems to eliminate these traditional tools rather than add to them, even if the people are willing to utilize them. We need these financing tools or the only alternative for action will be pressure for federal grants.

## RECOMMENDATIONS TO INCREASE THE POSSIBILITY OF EFFECTIVE DESIGN AND IMPLEMENTATION PROGRAMS IN THE FUTURE

### Local Government Actions

Setting up a pilot program in specified areas of the Country for an integrated management mitigation program would be advantageous as a model and an incentive. Hazard mitigation and safety programs are often the stepchild of other programs such as land use, construction standards, emergency preparedness, education, fire protection, flood control or other separate programs. These pilot programs would be designed to integrate a program focused on hazard mitigation as a primary goal. They may do any of the following:

1. Set up effective models to evaluate hazard mitigation techniques and successes.
2. Determine organizational characteristics of successful safety and hazard mitigation agencies.

3. Determine most effective public information and education programs.
4. Determine effective recordkeeping for hazard management.
5. Evaluate use of volunteers in hazard mitigation inspections.
6. Evaluate use of variable building construction standards.
7. Analysis of reasons for death and property loss to determine what hazards actually caused the most death and property loss.
8. Determine the most appropriate role of the various governmental entities--including the private sectors and universities.
9. Evaluate whether or not the best mitigating measures are self-imposed as the result of outside guidelines or outside mandates.
10. Risk analysis of the area.
11. Determination of the most cost effective mitigation measures.
12. Determine optimum levels of equipment, its ownership and location.

A blue ribbon committee of prominent citizens and governmental officials should determine the scope and guide the direction of the study, utilizing expertise from adjacent universities to provide consistent and statistically reliable evaluation of the programs. The findings could be distributed through the participating agencies and later through the State and Federal organizations which represent cities, counties and special districts, as well as Federal organizations with which they coordinate their programs. To emphasize the need for leadership and to recognize the leaders, appropriate dinners, certificates, or recognition by higher levels of government would be valuable to keep the leaders leading.

A second program for local government could involve a pilot program of recordkeeping for hazard management. Recordkeeping sounds like the essence of a bureaucratic program, but it is extremely difficult for property owners, residents or builders to obtain records of building and property hazards. They might do so if local governments kept such information in one easy reference spot or computerized it by parcel or made a requirement for it to be included on all subdivisions or title reports. It is a simple program on surface but its implementation on a state basis has caused bitter battles in the state legislature probably due to the effect it might have on property values and property encumbrances.

## STATE ACTIONS

The impact of the State guildelines on local policies should be determined where states have issued such guidelines. In most cases they have not been mandated and special studies could determine whether these guidelines have been effective in the actual mitigation of hazards.

An alternative program could involve the ranking or rating of local government hazard mitigation programs by a State or Federal agency, with no mandate for requirements to meet Federal standards or State standards. It could then be determined if this added visibility is effective in reducing natural hazards.

A third study could review the cost effectiveness problems of mandated requirements at the local level and alternative financing sources for meeting the problems which such mandates might raise.

## FEDERAL ACTIONS

Federal government impacts local government in a number of ways and they may relate to it by any one of the following programs:

1. An independent review of the safety standards and hazard mitigation programs on major Federal projects by the appropriate State or local agencies.

2. A requirement that Federal funds used for building purposes by State and local governments not be used until the project has addressed and identified natural hazards.

3. An adoption of Federal standards for Federally constructed projects on Federal land or leased facilities built to Federal specifications, with the provisions that these known standards be used or the State or local standards be used whichever is higher.

4. The adoption of standards for interstate lifelines of water, power and transportation that may affect a local area if the disaster wipes out one of these important facilities not under the control of the local jurisdictions.

## SUGGESTED CHANGE IN THE FEDERAL EARTHQUAKE HAZARD REDUCTION PROGRAM

FEMA has just been organized and assigned the responsibility for implementing the Federal Earthquake Hazard Reduction Program. In its first months, it would be expected that time would be necessary to assimilate large blocks of existing programs and reorganize it into a smoothly functioning new agency. Even with those problems, FEMA's presence at the State and local level has been increasing in the last months. They have become an integral part of the Western States Seismic Policy Council and, therefore, can communicate and work with employees and officials at the State level.

Their emergency preparedness programs which involve the evacuation of people from the Los Angeles area and surrounding counties in case of earthquake or other disaster, has touched many levels of local government. They have begun to develop seismic resistant design standards for use in Federal construction programs, and have involved local governments in recommendations regarding the evaluation or ranking of certain proposed research projects.

If there is one common thread of concern as voiced by the report from the Western States Seismic Policy Council, by the California Seismic Safety Commission, and by various local governments, -- it is a far more effective way for local government to become a part of an applied research program that focuses on the needs and problems of local government with the research providing alternative solutions. They do not wish to become part of a basic research program and leave that to the expertise of others. It is recognized that there are pioneering approaches in various universities to bring users and researchers together, but it is generally to parade the research to the local government officials in the hopes that they can use it. The emphasis in this needed type of research in problem solving should focus on a recognized problem with some mechanism to obtain a wider support for a local government consensus of opinion that the problem is important enough to send to a research group for consideration and acceptance by a qualified researcher. An alternative program would be to give local governments certain credits, points or dollars which they could allocate to buy or authorize specific research programs. Local government might also have an overview or a monitoring of the progress of the research so that they have a vested interest in it, and would be more able and ready to use it when it is finally appears in a finished form.

The concern of this committee in the field of an intergrated hazard reduction program is most timely; it is most important; and we welcome and applaud your interest in it. If we can be of any further help, please let us know.

Mr. Brown. Thank you very much.

In all honesty, I do not think I have seen a better statement in terms of comprehension, imagination and practical suggestions as far as the implementation aspects of an integrated hazard mitigation program, even including that last defensible suggestion about food stamps. We are actually working on programs now in recognition of the high priority of subsidizing users and researchers so that they may work on applied problems.

By that I am talking about getting industry and university researchers together with the encouragement of a Federal subsidy in some way so that they can do the sort of thing you have hinted at here in your statement.

I particularly like the suggestion you have made with regard to having a pilot project, and it could be one or more pilot projects, I suppose, for an integrated hazard mitigation program. This could be a major applied research program in itself and determine the relative effectiveness of the various ways of going about this.

I think what I would like to do is take your statement and make sure that it gets circulated to the FEMA people and the NSF people and see if they will rise to the bait.

Mr. Rigney. We would be happy to dangle it wherever the waters look good.

Mr. Brown. I think we can arrange that.

All right. If I may, I would like to go ahead to our last and obviously our best witness of the whole day, Mr. George Mader, chairman of the California Seismic Safety Commission.

Mr. Mader. Well, at least the witness who has waited the longest, perhaps.

Mr. Brown. I am sure that you are going to be the best.

[The biographical sketch of Mr. Mader follows:]

### George G. Mader

Mr. Mader is Vice-President of the city and regional planning firm of William Spangle and Associates, Inc. located in the San Francisco Bay Area. He is Chairman of the California Seismic Safety Commission, and was an advisor to the predecessor Joint-Committee on Seismic Safety of the California Legislature. He is a senior lecturer in the School of Earth Sciences at Stanford University. In recent years he has served on advisory groups to the President's Office of Science and Technology Policy and to the National Science Foundation. He is a member of the American Institute of Certified Planners.

Mr. Mader obtained his undergraduate degree in geography from UCLA and his Master of City Planning degree from the University of California at Berkeley in 1956. He studied regional planning at the Technical University at Delft, The Netherlands, under a Fulbright Grant in 1958–59.

Mr. Mader has been actively engaged in city and regional planning, principally in California, for twenty-five years. His work has consisted largely of advising local government regarding the preparation of general plans and regulations and their administration. He has, in addition, specialized in the application of geologic information in land use planning.

He has been a principal author on several reports prepared for USGS regarding the application of earth science information in land use planning. Currently, he is the principal investigator on an NSF-funded research project entitled "Post Earthquake Land Use Planning." In addition, he has written many articles on the topic of land use planning and geology.

## STATEMENT OF GEORGE G. MADER, CALIFORNIA SEISMIC SAFETY COMMISSION

Mr. **Mader**. Thank you, Mr. Chairman.

It is indeed an honor to appear before your committee. I have been asked to address the topic of land use planning as a method of earthquake hazard mitigation.

As an introduction, I would like to briefly provide some context for considering land use planning. Land use planning, can be effective in reducing earthquake hazards. However, its success depends upon many factors, including the state-of-the-art in seismic, geologic and structural engineering matters, the availability of basic information, public understanding of seismic hazards, professional competence, and legislation. Thus we see this land use planning as one of an integrated set of earthquake hazard mitigation factors, and therefore properly as one part of the national earthquake hazards reduction program.

I have been asked to address three specific land use planning topics.

First, how can land use planning be made an effective part of an earthquake hazard mitigation program?

Land use planning at the local level can contribute to an effective earthquake hazard mitigation program through the adoption of plans and regulations responsive to seismic concerns. General or comprehensive plans adopted by communities for future growth can take seismic hazards into account and channel growth to avoid the most hazardous areas or otherwise recommend mitigative actions. These plans must be based on sound information on seismic hazards.

Implementing regulations including zoning and subdivision regulations can effectively require that new developments be permitted only after adequate geologic data is obtained and used. Through those ordinances, detailed geologic and seismic data can be acquired.

Building and grading codes are important and are the next stages in the development process. Through these codes, we require very detailed data at the time construction takes place. Also, we are seeing a trend in California of communities attempting to modify building codes to get at the old hazardous building problem. This involves lowering standards somewhat so as to still provide for life safety, but not necessarily the same degree of structural safety that we provide for in new buildings. The point is to make it more attractive financially for building owners to improve the safety of their buildings.

Also, the public and private sectors can use normal renewal activities to rid cities of old hazardous buildings and replace them with new buildings.

After earthquakes, we should take action to see that reconstruction meet up-to-date standards.

With all of the foregoing land use planning actions possible, what are some of the problems we face in carrying them out? I would like to address four factors that I think affect this.

The first factor is prediction. Improvements in our ability to predict earthquakes will allow us to better program mitigative actions based on the imminence of the event. Improved predictions should greatly increase the planner's chance of convincing decisionmakers that there is a real public threat that requires mitigative actions. This predictive ability should make the planner's recommendations more favorably received. These comments also pertain to increasing our knowledge of earthquake recurrence intervals.

The second factor is education. Education of the public at large and of the planning profession relative to seismic hazards and mitigative actions is needed. Professional planning schools need to increase their attention to this natural hazard.

The third factor is funding. Funding at the local level appears to be insufficient to the task at hand. Local planning programs cover a broad range of topics and competition for funds is intense. Safety oriented planning efforts relative to earthquakes are not as glamorous or as pressing as many other demands. Hence, inadequate resources are typically brought to bear on the problems.

The fourth factor is narrowness of focus. Even in areas with considerable seismic hazards, a focus solely on seismic hazards is often ineffective. Other hazards, such as nonseismically induced landslide subsidence, erosion, flooding and fire, if looked at collectively, would enhance the opportunity for multihazard mitigation programs.

The second land use planning topic I will address is: How does the California Seismic Safety Commission encourage effective land use planning to mitigate seismic hazards?

Our Commission was established in 1975 as the outgrowth of a joint legislative committee established in 1969. The joint committee was responsible for two important laws relative to land use planning.

The first requires that all cities and counties in California have seismic safety elements as part of their mandatory general plans. The second law provides for geologic investigations and building restrictions along active earthquake faults in the State.

The Seismic Safety Commission has continued to review these laws and recommend refinements as necessary. Recently, the Commission sponsored legislation that was adopted which allows local governments to adopt lesser building standards for old hazardous buildings in order to encourage their rehabilitation.

The Commission's interests are broad as witnessed by its past involvement in matters much as the controversial Auburn Dam and proposals for liquified natural gas terminals along the California coast.

Currently, the Commission is working on a variety of projects including an education program to be used in public schools, improved standards for mobile home installations, and State requirements that all subdivisions have geologic reports prepared.

There are many other things that could be discussed with respect to the Seismic Safety Commission which time does not permit. However, the Commission does continue to take an overall view of land use planning, as well as many other facets of seismic safety, in the State.

The final land use planning topic I would like to address relates to the national earthquake hazard reduction program. I would preface my comments with the observation that the implementation of the program seems to be proceeding in an effective manner. I am aware of many products that are advancing our knowledge and providing important information.

My comments regarding areas that need additional attention are not intended as criticism of activities that are currently being undertaken. Also, some of my comments may stray from the current narrow provisions of the national earthquake hazards reduction program.

First, I would like to see increased efforts in education relative to seismic safety. In particular, this should be a topic of concern at city planning schools across the Nation. The topic has very little, if any, visibility at most planning schools. As has probably been pointed out in prior testimony, seismic hazards are not as limited in the United States as many would believe.

Federal encouragement and funding could spur this effort on. The education effort should also extend to public decisionmakers and the public at large. Public understanding and support is crucial to improved earthquake hazard mitigation in general and improved land use planning for earthquake hazard mitigation.

Second, I would like to see grants made to States and, particularly, to local governments to address land use planning for seismic hazards. There is a wealth of local talent in the seismically active areas of this country that could be devoted to innovative research and application.

One of the best methods to tap this talent in a very practical way is to provide grants or assistance for studies and action programs at the local level. These grants could produce research, but also move governments ahead in a very real way to plan for earthquake hazard mitigation. If effective land use planning actions to reduce seismic safety at the local level are desired, this would be one of the most effective ways to make progress.

Third, I would suggest that attention be given to the topic of multiple hazards. In planning for urban and rural areas, all natural hazards need to be considered. Mitigative actions for one hazard may be appropriate for a second hazard or may need modification to respond to both hazards. Thus, when multiple hazards are considered, the compounding effect may require a much different or more dramatic remedy. In practice, we find that very often areas of hazard are, in fact, areas of multiple hazards.

The benefits from considering multiple hazards are several, in addition to those already mentioned. From the Federal point of view, Federal or federally sponsored actions should not be shortsighted, but should look ahead to all possible hazards to the extent reasonable. No one wants to stabilize an area for a highway, for instance, only to have it washed out in a flood.

There is a second benefit of concern. Part of the lack of interest in seismic matters in the planning profession, and indeed the planning schools, is the narrowness of focus on seismic safety when viewed in an urban context. The planner must be informed and able to deal with so many other broad problems, such as housing, employment, and environmental quality, that seismic safety must of necessity not be a central concern. If increased focus is given to multiple hazards, then the base of interest within the profession and across the Nation can be heightened. A multiple hazard approach would serve to bring those professionals involved in a variety of hazard problems together in a most unified approach to hazard mitigation.

Fourth, I would like to mention the need of the Federal Government to take seismic safety into account in its many ongoing programs that are included in the earthquake hazard reduction program.

Finally, I would like to support the efforts of the Federal Government to prepare damage estimates and contingency response plans for those metropolitan areas with high seismic risk. My comments extend to the new efforts to identify the risks to the economies of these areas. I would, however, recommend that these efforts be extended to the identification of major physical damage throughout the areas and the major problems of post earthquake reconstruction that will follow the earthquakes. I believe that expanding these major efforts to land use planning would be very fruitful in coming to grips with the problems we may really face after the next major earthquake in one of our metropolitan areas.

Thank you for the opportunity to submit these comments. I have edited what I submitted considerably, and I would like to leave that edited comment with your committee.

[The prepared statement of Mr. George G. Mader is as follows:]

## Prepared Statement of George G. Mader

### LAND USE PLANNING AS A METHOD OF EARTHQUAKE HAZARD MITIGATION

I have been asked to address the topic of land use planning as a method of earthquake hazard mitigation. First, I would like to briefly provide some context for considering land use planning. Land use planning can be effective in reducing earthquake hazards; however, its success depends upon many factors, such as: the state-of-the-art in seismic, geologic and structural engineering matters; the availability of basic information about areas; public understanding of seismic hazards; professional planning competence in this field; and legislation. Land use planning is but one part of an integrated approach to seismic hazard mitigation. The National Earthquake Hazards Reduction Program addresses a broad range of actions, and its implementation has been of assistance to planners by providing a better understanding of earthquakes, structural behavior, and the way in which society responds to earthquakes. Nonetheless, additional actions can be taken to improve the likelihood that land use planning will be used for seismic hazard mitigation.

I have been asked to address three questions in particular: how can land use planning be made an effective part of an earthquake hazard mitigation program, how does the California Seismic Safety Commission encourage effective hazard mitigation planning, and what suggestions can be made for changes in the National Earthquake Hazards Reduction Program relative to land use planning. I will address each of these questions in turn.

### HOW CAN LAND USE PLANNING BE MADE AN EFFECTIVE PART OF AN EARTHQUAKE HAZARD MITIGATION PROGRAM?

Land use planning at the local level can contribute to an effective earthquake hazard mitigation program through the adoption of plans and regulations which are responsive to seismic hazards. First, general or comprehensive plans adopted by communities for future growth can take seismic hazards into account and channel growth so as to avoid the most hazardous areas or otherwise recommend mitigative actions. These plans must be based on sound information on seismic hazards. Next, implementing regulations including zoning ordinances and subdivision regulations can effectively require that new developments be permitted only after adequate geologic data is obtained and used. Up-to-date grading and building codes can go the final step in ensuring that construction recognizes seismic hazards. Building codes can also be adjusted to encourage the strengthening of old buildings to provide for life safety but not require the greater expense of meeting codes applicable to new buildings. Also, public and private renewal activities can help rid cities of old hazardous buildings and replace them with new buildings. After earthquakes, actions should be taken to ensure that reconstruction meets up-to-date standards.

What are some of the specific factors that hinder more extensive use of land use planning as a mitigation measure? I will discuss four of the factors:

1. Prediction—Improvements in our ability to predict earthquakes will allow us to better program mitigative action based on the imminence of the event. Improved predictions should greatly increase the planner's chance of convincing decision-makers that there is a real public threat. For this predictive ability should make the planner's recommendations more favorably received. These comments also pertain to increasing our knowledge of earthquake recurrence intervals.

2. Education—Education of the public at large and of the planning profession in particular relative to seismic hazards and mitigative actions is needed. Professional planning schools need to increase their attention to this natural hazard.

3. Funding—Funding at the local level for land use planning relative to seismic hazard mitigation appears to be insufficient. Local planning programs cover a broad range of topics and competition for limited funds is intense. Safety oriented planning efforts relative to earthquakes are perceived as not as glamorous or as pressing as many other demands. Hence, inadequate resources are typically brought to bear on the problems.

4. Narrowness of Focus—Even in areas with considerable seismic hazards, a focus solely on seismic hazards is often ineffective. Other hazards such as non-seismically induced landslides and subsidence, erosion, flooding and fire, if looked at collectively, would enhance the opportunity for multi-hazard mitigation programs.

Some recommendations relative to these four areas will be touched on at the conclusion of my remarks.

## HOW DOES THE CALIFORNIA SEISMIC SAFETY COMMISSION ENCOURAGE EFFECTIVE LAND USE PLANNING TO MITIGATE SEISMIC HAZARDS?

The California Seismic Safety Commision, established as an independent commission in 1975, was the outgrowth of the Joint Committee on Seismic Safety of the California Legislature formed in 1969. The Joint Committee was responsible for two important laws relative to land use planning. The first requires that all cities and counties in California have seismic safety elements as part of their mandatory general plans. The second law provides for geologic investigations and restrictions on building along active earthquake faults. The Seismic Safety Commission has continued to review these laws and recommend refinements. Recently, the Commission sponsored legislation, that was adopted, which allows local governments to adopt lesser building standards for old hazardous buildings in order to encourage their rehabilitation while still meeting life safety requirements. The Commission's interests are broad as witnessed by its past involvement in the controversial Auburn Dam proposals for liquified natural gas terminals along the California coast.

Currently, the Commission is working on a variety of projects including, among others, an education program to be used in public schools, improved standards for mobile home installations and state requirements that all subdivisions have geologic reports prepared. The Commission's concerns extend beyond the state, as witnessed by the Commission's involvement in the year-old Western States Seismic Policy Council. There are many other programs the Commission is involved in, but which time does not permit mentioning.

## SUGGESTIONS FOR CHANGES IN THE NATIONAL EARTHQUAKE HAZARD REDUCTION PROGRAM

I will preface my final comments with the observation that the implementation of the Earthquake Hazards Reduction Program seems to be proceeding in an effective manner. I am aware of many products that are advancing our knowledge and providing important information. My comments regarding areas that need additional attention are not intended as criticism of activities that are currently being undertaken.

First, I would like to see increased efforts in education relative to seismic safety. In particular, this should be a topic of concern at city planning schools across the nation. The topic has very little if any visibility at most planning schools. As has probably been pointed out in prior testimony, seismic hazards are not as limited in the U.S. as many would believe. Federal encouragement and funding could spur this effort. The education effort should also extend to public decision-makers and the public at large. Public understanding and support is crucial to improved land use planning for earthquake hazard mitigation.

Second, I would like to see grants made to states and, particularly, local governments, to address land use planning for seismic hazards. There is a wealth of local talent, geologists, structural engineers and planners, in seismically active areas of this country that could be devoted to innovative research and application. One of the best methods to tap this talent in a very practical way is to provide grants or assistance for studies and action programs at the local level. These grants could produce research, but also move local governments ahead in a very real way to plan for earthquake hazard mitigation. If effective actions to increase seismic safety at the local level through land use planning are desired, I believe this would be one of the most effective ways to make progress.

Third, I would suggest that attention be given to the topic of multiple hazards. In planning for urban and rural areas, all natural hazards need to be considered. Mitigative actions for one hazard may be approrpiate for a second hazard. Or, when multiple hazards are considered, the compounding effect may require a different or more dramatic remedy. In practice, we find that areas of hazard very often are, in fact, areas of multiple hazards.

The benefits from considering multiple hazards are several in addition to those already mentioned. From the Federal point of view, Federal or Federally-sponsored actions should not be shortsighted, but should look ahead to all possible hazards to the extent reasonable. No one wants to stabilize an area for a highway, for instance, only to have it washed out in a flood. There is a second benefit. Part of the lack of interest in seismic matters in the planning profession, and indeed the planning schools, is the narrowness of focus on seismic safety when viewed in an urban context. The planner must be informed and able to deal with so many broad problems such as housing, employment and environmental quality, that seismic safety must of necessity not be a central concern. If increased focus is given to multiple hazards, then the base of interest within the profession and across the nation can be heightened. Also, a multiple hazard approach would serve to bring those professionals involved in a variety of wayward problems together in a more unified approach to hazard mitigation. Attention to multiple-hazards, however, should not be allowed to evade the earthquake hazards reduction program and therefore, may need to be shared with other programs.

Fourth, I would like to mention the need of the Federal government to take seismic safety into account in its many on-going programs. The Federal government can set an example through exemplary planning for its own projects and any projects aided through Federal funding. This is an extremely broad topic and is indeed one addressed in the National Earthquake Hazards Reduction Program. These matters need to be pursued vigorously by the Federal government.

Finally, I would like to support the efforts of the Federal government to prepare damage estimates and contingency response plans for those metropolitan areas with high seismic risk. My comments extend also to the new efforts to identify the risks to the economics of these areas. I would, however, recommend that these efforts be extended to the identification of major physical damage throughout the areas and the major problems of post earthquake planning and reconstruction that will need to be addressed if major earthquakes do occur.

Thank you for the opportunity to present these remarks to your committee.

Mr. **Brown**. We want to thank you very much, Mr. Mader, for your excellent paper. I very much appreciate personally your emphasis upon the need to consider multiple hazards. That is the kind of a concept that I think we are having the most difficulty In getting across, and if you combine that with a similar concern that we look at this in a cross-disciplinary way, I think we then have a basis for undertaking the kind of general planning that I think you would like to see, and which I think is necessary.

When we just focus on one type of thing, we become guilty of the sin which I refer to as "suboptimization," that is, we do a good job on one thing and neglect the whole.

If you will forgive a further reference, the great philosopher Liebnitz commented on this in his discourse of metaphysics when he said the design of the element can only be measured by the quality of the whole of which it is a part.

You would agree with that. All right. I am not going to pursue this any further before I get in over my head.

We do thank you very much.

We had one additional witness, City Councilman Hal Bernson from Los Angeles, who was going to testify in place of Ms. Rachael Dunn, president of the building and safety commission. Unfortunately, Mr. Bernson had to return to Los Angeles, something which I can understand, but the full test of his statement will be placed in the record also at this point.

[The biographical sketch and prepared statement of Mr. Hal Bernson is as follows:]

# BIOGRAPHY

| | |
|---|---|
| NAME: | Hal Bernson |
| PRESENT OCCUPATION: | Currently serving his first four-year term in public office as a Member of the Los Angeles City Council representing the Twelfth District. |
| PAST OCCUPATION: | Thirty years in the clothing retail business. Presently the owner of The New Breed custom T-shirt store in the Northridge Fashion Center. |
| BIRTHDATE: | November 19, 1930 |
| BIRTHPLACE: | Los Angeles, California. Resident of the San Fernando Valley since 1957. Has lived in the Twelfth District for the past 13 years. |
| MARITAL STATUS: | Married. Wife, Robyn. Three daughters, Nicole, Holly, and Sarah. |

## PRESENT LOS ANGELES CITY COUNCIL COMMITTEE ASSIGNMENTS

Building and Safety Committee, Chairman

Public Works Committee, Vice-Chairman

Planning and Environment Committee, Member

## PRESENT COMMUNITY ACTIVITIES

Co-founder and Board Member of CIVICC (Committee Investigating Valley Independence for the City/County)

Member of the Granada Hills, Northridge, and Reseda Chambers of Commerce, Greater San Fernando Valley Chamber of Commerce, and United Chambers of Commerce.

Past Committee Chairman and Member of the Local Government Committee for the Northridge Chamber of Commerce

Former Board Member and Member of the San Fernando Valley Business and Professional Association

Member of the San Fernando Valley Industrial Association

Past President and Co-founder of the San Fernando Valley Breakfast Forum

Patron of the Fernando Award Committee

Member of the Easter Seal 500 Club

## PAST COMMUNITY ACTIVITIES

Northwest San Fernando Valley Chairman for Senator Alan Robbins' anti-busing initiative and amendments (1977-1979)

Member of the Steering Committee for Yes on Proposition 13 (1978)

Member of the Citizen's Advisory Committee for Downtown Redevelopment (1975-1979)

Member of the Committee Against the North Valley Landfill (1978)

Columnist for The Canoga Park Chronicle newspaper (1978-1979)

Chairman for the Citizen's Committee for Better Zoning (1967)

Past President of the Reseda Merchants' Association (1966-1967)

### TESTIMONY OF COUNCILMAN HAL BERNSON

Good afternoon. I am pleased to be with you to discuss the efforts of the City of Los Angeles in the areas of earthquake hazard mitigation and earthquake preparedness planning and to suggest some federal action as your subcommittee considers the reauthorization of the Earthquake Hazards Reduction Act of 1977.

I am the chairman of the City Council's Building and Safety Committee, and, of course, one of the interests of this Committee is earthquake mitigation and preparedness planning. As you are aware, the City of Los Angeles and the State of California have suffered several severe earthquakes within this century. The last big earthquake registered 6.5 on the Reichter Scale. This was the 1971 San Fernando Earthquake, and it was very destructive killing approximately 80 people, injuring many more, and causing millions of dollars in property damage. Since then, the City has experienced other earthquakes—though not so destructive—and we expect more in the future. From the time of the 1971 earthquake, the City has stepped up its efforts to mitigate the effects of an earthquake. The City's building code has contained structural standards to reduce the vulnerability of buildings to earthquakes since 1934, and these standards have been upgraded periodically over the years as the State-of-the-Art developed.

The City has a specific earthquake operations plan located within the General Disaster Plan. The earthquake operations plan specifically designates the responsibilities of the various City departments after an earthquake. In addition, we have completed a program to correct the vulnerability of hazardous parapets to earthquakes, and we now have programs to do the same for bridges, elevators and dams. Further, we have also prepared a City ordinance requiring approximately 8,000 pre-1934 unreinforced masonry buildings to be brought up to the minimum seismic code standards proposed by the ordinance. This is a 10-year program, requiring "essential buildings" to be upgraded during the first two years. These are mostly public buildings belonging to the city, such as fire and police stations. In case of a damaging earthquake, these "essential buildings" must say in place as the equipment and personnel will be needed to help others.

Preliminary estimates of the cost to upgrade all of the buildings under the ordinance have ranged from $500 million to $1 billion. Since there is a great disparity between the two estimates, the City Council, at my request, authorized a $30,000 study to get a better idea of the actual overall cost. The study will be completed in April of this year, and will cover the costs to rehabilitate five different structures typical of hazardous older buildings.

What ever the results of the study are, we know that the costs will be high. And this brings two problems: (1) The possible displacement of tenants, and (2) Financing the rehabilitation.

Improvements in rental units (the proposed ordinance only applies to buildings with five or more units) will undoubtedly cause the rents to rise. The City has a severe housing shortage with only 2.4 percent of the housing stock available for rent at any one time. This puts further pressure on housing costs and results in increased rents and decreases the amount of low and moderate income rentals available. Many of the rental units which will be affected by the ordinance are in the inner city and inhabited by the poor, including the elderly living on fixed incomes. If their rents are raised as a result of the improvements, they may be forced out of their housing with little or no choice for alternative housing. This is one of the most difficult problems the City faces in dealing with the possibility of a very destructive earthquake. It comes to making a choice between providing housing which is safer and possibly putting on the streets those who were meant for the safer housing or doing nothing at all to rehabilitate residences and risk losing many more lives during a severe earthquake. It is a very real "Catch-22".

Some tenants and both commercial and industrial property owners still see the proposed ordinance as punitive and arbitrary in nature. As a result, the City is trying to help property owners receive financial assistance which would reduce or eliminate their costs.

I have set up the Special Financial Advisory Committee on the Seismic Safety Ordinance made up of key members of the City's financial community. I have found that they are not very interested in providing substantial loans on high-risk buildings as they would prefer to spend their scarce funds on new construction. At a recent meeting, however, the members indicated to me that earthquake insurance must be available on the hazardous buildings after their rehabilitation if loan dollars are to be available. I have attached copies of the results of the meetings of the Advisory Committee to my testimony.

In our efforts to find financing for property owners, we have investigated possible funding from other sources, such as the City's proposed Municipal Finance Agency, and various State and federal programs. We feel that the Congress and the Executive Branch could make some changes which would assist the property owners to bring their buildings up to the proposed earthquake code or to help the City strengthen such public works as bridges.

We have found that there is a lack of consistency in the interpretation of Section 312 of the National Housing Act of 1964 relating to housing rehabilitation. It is not clear if a potential applicant for funds must be located in a designated area of the City. The guidelines themselves make no such limitation, but the Department of Housing and Urban Development has. We recommend that the guidelines be interpreted as broadly as possible if life and safety are at stake.

The Bridge Improvement and Replacement Act should be amended to promote the strengthening of bridges to meet earthquake stresses. The City has 150 bridges which must be strengthened. Of these, 37 are of critical concern. Work will begin on three bridges this year, with eight more scheduled over the following two years. The City uses gas tax monies for this work, and as you can see it will take many years just to upgrade the critical 37 bridges. By amending the law, federal funds would be available to strengthen the bridges and the job would be completed sooner.

As this Subcommittee and the Earthquake Hazards Reduction Act are concerned with research, I will describe City activity in this area. We have already completed a study of a portion of the Palmdale Bulge. And now, another committee which I sponsor, the Ad Hoc Committee on Earthquake Grant Proposals, made up of representatives of concerned City Departments, has begun to present suggestions for research. They will be finalized in the near future. The following are some of the suggestions: (1) Evaluate potential damage to harbor installations, small craft, breakwaters and dike by tsunamis and seiches; (2) find the effect of a comprehensive seismic safety program on earthquake insurance; (3) formulate procedures for handling earthquake predictions; (4) formulate a plan for post-earthquake reconstruction; (5) create a data system for estimating potential earthquake damages; (6) develop an all-important public education program; (7) evaluate and update the City's hazardous materials code with respect to earthquake hazards; (8) study the liquefaction potential of the soil; (9) conduct a microzonation study of possible ground motions and soil instability; (10) evaluate residual static strength of various soils; (11) co-relate dynamic soil strength and properties with laboratory parameters; (12) investigate the dynamic strength of gravelly and rockfill materials; (13) study the effects of prior low-level cyclic strength of soils; and (14) study the effects of sample preparation on dynamic soil strength.

Federally-funded research should result in practical application. Several of the topics I just mentioned can be put to such use for comprehensive planning. However, they would be handled more effectively if such planning were undertaken jointly by the City, the State and the federal governments. For instance, there should be more State and federal involvement in comprehensive preparedness planning, such as that being done on the Disaster Housing Plan. The City is working with the Federal Emergency Management Administration (FEMA) on this plan to ensure that those made homeless by a disaster would have their immediate and long-term shelter needs addressed and met. This Plan is the first of its kind: It uses a hypothetical disaster, looks at the workload the disaster would cause, decides what needs to be done, reviews the resources available to handle the needs, and then assigns the responsibilities to the appropriate City, State and federal agencies. For example, the City can provide zoning waivers and temporary mobile home sites to the homeless, while the State and federal governments can provide other services to assist the homeless meet their needs for permanent shelter. At this time, the background research of the Plan has been completed. The Plan itself is expected to be prepared by early summer. FEMA can provide you with a more complete report on the Plan.

This Plan is only for assisting the homeless. When it comes to a disaster, there are other areas which need comprehensive planning. These areas include planning for medical, transportation and communications needs as well as the creation of one-stop disaster assistance centers.

Earthquake prediction is a new and developing field. When scientists learn how to predict earthquakes, new concerns will arise that the City by itself may not be able to adequately address. However, we are not waiting for the scientists.

The City has already begun to act by sponsoring a task force on earthquake prediction preparedness which developed the report attached to my testimony. As a result of the report, the City is developing an Earthquake Prediction Response Plan that will direct the City's final preparation and action for any predicted earthquake.

In addition, federally-funded research on the economic consequences of prediction would be helpful. This would involve the development of risk assessment systems to predict the distribution of an earthquake's possible damages once the focal point, time and potential intensity of the predicted earthquake is known. Risk assessment systems would enable the City to advise citizens of ways to reduce losses. For instance, what should business and industry do following an earthquake prediction? Knowing the focal point of the predicted quake, its potential intensity and the time it will occur as well as the location of the business will enable the City to work with an individual business to mitigate the damage of the business, and thereby reduce the economic consequences of an earthquake. If such coordination does not take place when a prediction is made, business may choose to move out of the area (if there is enough time) or take other measures harmful to the economic activity of the community.

The City of Los Angeles is a national leader in the area of earthquake mitigation and earthquake preparedness planning. However, there is still much to do. As we complete what we need to do, it is our hope that the results, of our efforts would be useful to other communities.

Again, I express my appreciation to the subcommittee for the opportunity to provide you with information on what the City of Los Angeles is doing on the issues of earthquake mitigation and earthquake preparedness planning and to suggest ways the federal government could be of help to us.

Thank you.

Mr. BROWN. And with that, let me thank both of you gentlemen again, and again apologize for keeping you this long and for having to rush these proceedings along considerably more than I wanted to.

Let me assure you that we are going to make very good use of the testimony you have given us.

With that, the subcommittee will be adjourned.

[Whereupon, at 6:25 p.m., the subcommittee was adjourned.]

[Additional material submitted for the record follows:]

# CITY OF LOS ANGELES

## THE STRENGTHENING OF ELEVATORS AND DAMS

The following is a discussion of the City's efforts to strengthen elevators and dams.

### ELEVATORS

The City's program for bringing all elevators in the City up to seismic standards is to be completed by October 6, 1980. The program requires that elevator motors be bolted down so that this equipment will not shift during an earthquake. Secondly, restraints must be placed on the counter-weights to help them remain within their rails. Finally, sensors are attached to elevator motors to shut them down on the "P" wave. This wave arrives just before the other waves which cause the shaking.

The cost of upgrading elevators varies from $2,000 - $6,000, and is paid for by the building owners.

### DAMS

The City's Department of Water and Power (DWP) has more than 30 dams registered with the California State Department of Water Resources, Division of the Safety of Dams. The State and the DWP go on joint inspections of the dams periodically, and the DWP also makes semi-annual reports to the State on the condition of the dams. The DWP has a Master Plan for analyzing the dynamic stability of the dams, and preliminary analysis have been completed on all the dams. This Master Plan is expected to be.completed by 1985. The DWP began analyzing the older dams first, since these were more likely to not meet current standards. Several were found to be unsafe and were drained and taken out of operation. Others have had their water levels lowered until they can be repaired. Dams which cannot be repaired will be reconstructed.

The DWP also has an on-going surveillance program on the dams located within the City. There are five people working full-time on the program. These dams contain alarm systems which are linked to the DWP headquarter's Trouble Board, and whenever something unusual happens at one of the dams, the DWP knows immediately. There are eight people who can be called to look at the reservoir in question on any 24 hour basis. During the recent heavy rains, the Trouble Board in the DWP headquarters went off 20 times, and one of these eight people was immediately dispatched to the reservoir. None of the problems were serious.

The DWP's dam program is paid for by the ratepayers.

TO: Members of Special Financial Advisory Committee
on Seismic Safety Ordinance

SUBJECT: January 22nd Meeting -1980

At the request of Councilman, Hal Bernson, representative of banks and savings and loans, met at Security Pacific National Bank to discuss their specific concerns and recommendations regarding the design and implementation of a city sponsored program to finance seismic reinforcement of buildings. The participants were asked to comment on proposals made at an earlier meeting and to make any recommendations of their own. There were two areas of general discussion. The first dealt with assuring available credit, and the second with the design of any special program.

In the first area, the participants made it clear that as lenders, their function was to assess the credit risk in any loan request. In the seismic question, the major risk is the casualty risk, that is the risk of loss from earthquake which is not an economic factor. It was the consensus of the members that earthquake insurance must be available on these after rehabilitated buildings if loan dollars are to be available. They recommended to the city that its building and safety department contact and work with the casualty underwriters to be sure that they will accept the engineering conclusions regarding adequate reinforcement that the ordinance will specify, and will provide earthquake insurance. The provision of National Disaster or Earthquake insurance would be advisable if the private insurers could not comply.

Another aspect of funds availability which is currently significant, is the current high cost of money and some developing tightness. This factor was pointed out, but is impossible to assess in the time frame of the rehabilitation program.

Concerning the design of a program, including any incentives the city would provide, the lenders would accept any forms of grants, interest rate subsidies, tandem loans, etc. These would provide incentives to property owners and might reduce total costs. They did feel very strongly that any city sponsored program should be available to all affected property owners. Further, it should be limited to seismic rehabilitation and related items only.

Finally, it was recommended that the city provide a certification of any planned reinforcement, that it fully meets the requirements of the ordinance. Further, that it provide a list of lenders to prospective borrowers when it has completed its certification process.

The participants were sensitive to the issues of displacement and the erosion of the low cost housing stock that the ordinance may entail, but limited their comments to the area of financing.

After adjournment one representative had a suggestion which was not discussed by the full meeting, but is included here because of its apparent merit.

He suggested that the city contract with one organization to act as originator/servicer and supervisor of interim construction activities for all seismic reinforcement loans. This organization would be compensated by fees generated as is typical with bond programs. Loan funds would be provided through a pool created by a master loan syndication of the participating lenders. The proposal has merit because of the advantages that centralized processing gives in developing expertise and establishing communication between city department and the agent. Also it has the advantage of spreading the risk equally among lenders. Contributing lenders would provide a loan review board to assure consistency in the administration of the underwriting criteria. This proposal is similar to the SAMCO program adopted by many of the Savings and Loans in San Francisco during the early '70's. Because it was presented after adjournment, the support of the participants is unknown, however copies of this memorandum will be forwarded to all institutions originally invited to the January 22nd meeting with a request for their comments!

Respectfully,

Hugh D. Loftus
Chairman

November 30, 1979

To: Members And Prospective Members
Special Financial Advisory Committee On Seismic Safety Ordinance

Subject: November 28, 1979 Meeting On Financial Alternatives

At the above meeting, the individuals identified on the attached list met with Los Angeles City councilman Hal Bernson and members of the City's Building Department and Community Development Department, to identify and discuss some alternative methods of assuring the availability of financing for property rehabilitation required to achieve conformity with the pending seismic ordinance.

In our preliminary discussion the following points were made:

A. It is a general policy of the institutions represented not to lend to unreinforced masonry buildings built prior to 1933.

B. One of the areas of greatest concern is the impact that the proposed ordinance will have on the residential units in buildings effected are in the low and moderate income range.

C. Properties can generally be considered to be of low value for real estate loans, but should be relatively free of debt.

D. The City is interested and willing to discuss and devise procedures that would provide property owners with an incentive to rehabilitate and assistance to lenders making these loans.

From the discussion of possible financing vehicles, incentives, programs, etc., the following were given some consideration. They are presented in no particular order and do not represent all the solutions proposed.

1. The establishment by the City of a loan guarantee fund. Guarantees could be provided in much the same manner as private mortgage insurance on single family loans, insuring a certain portion of the lender's risk.

2. Payment by the City of interest rate subsidies to keep loan costs down and reduce presure on landlords to increase rents.

3. Issuance (and placement with participating financial institutions) of mortgage backed tax-exempt bonds to provide low cost funds for rehabilitation.

4. A modification in the rent control ordinance as it would effect the properties to provide additional incentives.

5. Use of the City Redevelopment Agency to provide funds; possibly to develop low cost replacement housing; allocate any portion of its tax-increment for rehabilitation.

6. "Wrap-around" loans where possible to provide a lower over all cost of rehabilitation, on properties with existing debt.

It is estimated that compliance will cost upwards of $500 million with a ten (10) year implementation schedule. The residential only portion accounts for approximately 40% of the total. The City Community Development Department is exploring several proposals with the Federal Government to secure specific aid for this area, but is not optomistic. Any assistance they provide will probably have to come from a re-ordering of current activities and re-allocation of resources.

Industrial and commercial properties are generally considered to have better alternatives in absorbing rehabilitation costs, as well as being eligible for E.D.A. and S.B.A. assistance.

At the conclusion of the meeting, these individuals concurred on the need for much broader involvement by the financial community, and volunteered to secure additional members and provide their names to Councilman Bernson. A copy of this meeting summary and additional material regarding the ordinance will be sent to each new member, and an additional meeting will be scheduled in the near future.

Signed: Hugh D. Loftus
Vice President
Security Pacific National Bank

HDL:jcr

1. Thomas G. Backer
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Valley News
10-25-79

# L.A. places $30,000 in earthquake study

By JOYCE PETERSON

Los Angeles, City Council members Wednesday appropriated $30,000 to find out how much it would cost to strengthen the city's 8,000 unreinforced concrete buildings to minimize loss of life in event of a major earthquake.

The 10 to 1 vote came amid soul searching over whether it was better to leave the elderly and poor in potentially unsafe dwellings or to order expensive improvements that could force them out of their homes.

"It really is a sad commentary on our society," said Councilman Zev Yaroslavsky.

In the end Councilman Hal Bernson, chairman of the council's Building and Safety, prevailed with a motion allocating the money so the city can get a better idea of the costs of an ordinance now under consideration.

The measure, proposed by a special commission, would require unreinforced pre-1934 structures erected prior to adoption of earthquake code be strengthened to make it less likely they would collapse in a severe temblor.

Building and safety officials have estimated such rehabilitation will cost $5 to $6 a square foot. Some architects have estimated the figure will be three to five times this much.

The $30,000 will be used for a pilot project on five different structures typical of the old red brick buildings found in the older portions of the inner city.

Councilman Arthur K. Snyder, who has many eastside constituents living in the unreinforced buildings, chided his colleagues for the city's long delay in taking corrective action.

Snyder noted it has been five years since he introduced a motion asking the buildings be upgraded and all the council has done is "studied, talked and fought."

He warned the council will be in for severe criticism if thousands of people are killed in an earthquake.

"No one knows if an earthquake is going to be in 30 minutes or 30 years or it may be 300 years but it is going to happen," he said.

Councilman John S. Gibson Jr. agreed that "people are going to die because of our neglect" and said the city itself is negligent for not improving its own older buildings such as City Hall.

But Councilman Joel Wachs said the situation was "not so simple." He said if the city requires expensive improvements the costs will be passed on to tenants in the form of rents they cannot afford. He said he had talked to many senior citizens fearful of being forced from their apartments.

"They were willing to risk the earthquake for the ability to have a shelter over their heads," he said.

Councilman Robert Ronka, who toured the El Centro quake area last Saturday with Bernson, said he had seen structures there which had stood up with only minimal reinforcements and that this was the kind of program needed in Los Angeles.

If the improvements are too costly, Ronka said, "you could have 100,000 people — many of them senior citizens and those on low incomes — who would be forced in the streets with no place to go.

The cost study on the five buildings will be done under a private contract and is due for completion in three months.

Councilman Marvin Braude, chairman of the Finance and Revenue Committee, cast the lone "no" vote.

## *Firm ideas for when earth quakes*

A pamphlet telling Los Angeles residents how they can prepare for earthquakes and minimize potential dangers is available at all city fire stations and libraries.

The pamphlet, "Earthquake — Safety and Survival," was prepared by the Department of Building and Safety.

Mayor Tom Bradley said basic information on hazardous building construction and furnishings is "important for every person living in this area."

# CONSENSUS REPORT OF THE TASK FORCE ON EARTHQUAKE PREDICTION CITY OF LOS ANGELES

Rachel Gulliver Dunne, Chairman

Presented to Mayor Tom Bradley
October, 1978

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# Executive Summary

## PRINCIPAL RECOMMENDATIONS

o The City should prepare an Earthquake Prediction Response Plan and establish the appropriate coordination and organizational functions to enable a prompt and effective response to any prediction of an earthquake within the region. The plan should provide criteria and contingency plans for a wide range of potential responses geared to the specific time, location, magnitude and probability (or confidence level) of the prediction. This Task Force report provides numerous suggestions and recommendations for incorporation in the Response Plan.

o Ongoing and proposed programs of earthquake safety should be designed for appropriate augmentation or acceleration in the event of a significant earthquake prediction.

o A new emphasis should be placed on public information for earthquake preparedness: families, individuals and neighborhoods will need to be self-sufficient for days and even weeks following a major earthquake, and special programs and materials should be prepared to encourage and assist in this preparation, which should be intensified following a significant earthquake prediction. Specialized programs and materials on earthquake preparedness should address the particular needs of children, the handicapped and the elderly.

o State and Federal actions should be sought on several important issues:

a. Enabling Federal disaster assistance to become available following the prediction of a major earthquake and in preparation for the anticipated disaster.

b. Provision of reliable earthquake insurance, either as a system of Federal earthquake insurance or as part of a Federal system of natural disaster insurance.

c. Clarification of the legal authority and liability of the City for responsible actions taken in response to an earthquake prediction.

o The Earthquake Prediction Task Force should be reconvened by the Mayor in two years (October, 1980) to review the progress in implementing its recommendations and to update its findings based on any changes in prediction technology, legislative action, available programs or public concern.

## SUMMARY OF FINDINGS

Although a reliable system of scientific earthquake prediction may not be available for a decade or more, a number of predictions are likely to be made during development of the science, and resulting public concerns and business reactions will necessitate responsive action by local government. A substantial savings in lives and reduction of property damage could be realized with a well-coordinated prediction response.

The scientific validity of predictions will be evaluated by the California Earthquake Prediction Evaluation Council (CEPEC) or its Federal counterpart, NEPEC, and a general earthquake warning will be issued by State or Federal officials if the prediction is verified. The City will need a capability to assess the local significance of the predicted earthquake and to issue local warnings as appropriate.

If an Earthquake Prediction Response Plan were developed before the first prediction is confirmed, the City could make maximum use of the available lead time when a warning is announced, and the advanced planning would allow a rational and timely selection of the components of response most appropriate to the specific characteristics of the prediction. The City could indicate its preparedness and immediately begin implementation of a carefully structured program.

The City should also be prepared to implement a beneficial response to an unconfirmed, pseudo-scientific or low probability prediction which might generate widespread public concern. The City should avoid reinforcing an unconfirmed prediction, but could respond to public concern by providing information and assistance that will help the public become better prepared for any earthquake.

### Earthquake Prediction Response Plan

The Earthquake Prediction Response Plan will need to establish a structure for 1) evaluating the local significance of any specific prediction, 2) determining the appropriate response, and 3) expeditiously carrying out the various aspects of chosen response. It should also identify ongoing goals that would make the plan more effective and provide a mechanism for period review and update as new programs, options and legal authority become available.

An Earthquake Prediction Response Plan should contain the flexibility to adjust to predictions of varying magnitudes, probabilities and lead times.

In planning for short, intermediate and long lead times, the number of days available will determine how much can be accomplished. For example, if an earthquake were predicted in a few days, emergency services could be readied, previously identified hazardous buildings could be evacuated, and nuclear reactors and petroleum pipelines could be shut down. With a one-month lead time, buildings could be inspected and hazards identified; contents could be braced; hospital patients could be shifted; reservoir and dam levels could be selectively lowered; and toxic materials could be moved or secured. With a one-year advance notice, buildings could be selectively reinforced and hazardous storage facilities could be replaced. With an advance warning of ten years, building codes and land use regulations could be revised and enforced, and hazardous dams could be replaced or removed from service.

### Economic Impact

A credible prediction of a damaging earthquake will have negative repercussions on the economy of the target community, especially if several years lead time is given. The longer the lead time, the more disruption there is likely to be. Problems will range from a decline in sales, property values and tax revenues, to the flight of capital, decreased availability of loans, and increased unemployment. Consturction of new buildings could virtually cease.

Constructive responses to an earthquake warning should include close liaison between the City and the private sector to (1) monitor the local economy, and (2) encourage mutually beneficial, coordinated action, as needed. Unemployment can be combatted by hiring people to work on earthquake preparedness or Public Works projects and by urging an extension of Unemployment Compensation.

If economic impacts become substantial, the federal declaration of a disaster area for the prediction area could provide funds for hazard reduction and perhaps for economic stabilization measures. Funding will be needed to offset the reduction in local tax revenues and to meet the increased demand for City services that would be created by the prediction. The provision of loan guarantees by the Federal or State government would help stabilize the local economy. Various funding sources should be investigated and promoted in advance of a prediction.

There will be a need for reliable insurance for earthquake damage, as no new policies of earthquake insurance will be issued following a credible prediction. Without such insurance, new loans will not be available. To prevent a local disaster from bankrupting individual companies or a single agency, the cost of insurance needs to be spread among a large number of buyers, preferably through a federal program of natural catastrophe insurance.

### Social and Psychological Impact

Few extreme reactions are expected from the populace as a whole in response to a significant prediction. Actual panic is not likely, but anxiety and apathy may be expressed by various segments of the population. Recommendations to the public should recognize self-interest as a widespread motivation by providing positive reinforcement with useful information and guidance to groups and individuals in preparation for the earthquake.

Public anxiety can be minimized by providing clear information on the many safe areas in the City and on specific hazardous locations, augmented with information and training on how to make the home, work place and travel routes relatively safe. Volunteer efforts and neighborhood mutual assistance programs should be encouraged. A centralized information center that would also function as a rumor control center would be very helpful in relieving public anxieties.

Problems of credibility will be inherent in the first few predictions. They can be reduced by clearly assessing and explaining the significance of the prediction within the local area and then selecting responses that are realistically geared to the specific prediction. Community leaders and other jurisdictions should be consulted for advice and support in the selection of a prediction response, and seminars for business and community leaders both before and after a prediction will promote wider confidence in the City's preparations.

If relocation or evacuation of residents becomes necessary, most people will prefer to move in with relatives and friends. Host families and sponsoring groups could assist those who have no place to relocate. Shelters will not be readily used for relocation, and are better adapted as information and assistance centers, both before and after the predicted earthquake.

Special attention and preparation will be needed to help maintain the psychological stability of children and families. The special needs of the elderly and the handicapped should be recognized and materials developed to help increase their preparedness. Special arrangements will need to be made to protect and reassure people confined in institutions.

## Public Information

Once a prediction is confirmed by the State or Federal evaluation councils, the Mayor should immediately announce the preparations that the City has made and the special measures that can be taken to safeguard the City and lessen adverse repercussions. He could also indicate the effects that the predicted earthquake is likely to have in the City, and the areas and types of buildings that should be relatively safe. Damage maps would help the people visualize the extent of expected destruction, identify safe areas as well as problem areas, and help focus the City's response actions. An Earthquake Preparedness Information Center should be activated to supply a wide variety of answers and information, and to function as a Rumor Control Center. The better understanding people have of the exact nature of the danger, the more calmly they will respond. The more information the City makes accessible to them, the more trusting of City policy and advice they will be. In addition to specific details about the predicted earthquake itself, citizens will probably want to know (1) how to protect themselves and their environment, (2) what to do during and immediately following an earthquake, (3) the kind of assistance available to them in relocation, home safety, and upgrading buildings, and (4) the locations of faults, dams, and other potential hazards.

## Safety of Buildings

Building collapse as a result of an earthquake is one of the greatest threats to life and safety, and the warning provided by a specific prediction will enable special precautions to be taken. Unreinforced masonry buildings, erected before 1934, are structures most susceptible to earthquake damage in Los Angeles today. A survey of the estimated 9,000 such buildings in the City is due to be completed in early 1979, and a correction code has already been drafted. A Response Plan could specify priorities and procedures for accelerating code compliance following a prediction, and for relocating occupants of uncorrected buildings. If the code is not adopted before a prediction is issued, there may not be sufficient time for enforcement after the warning comes.

Post-1933 buildings conform to the seismic requirements in effect at the time they were erected, but technological progress and new design concepts are constantly producing new methods of increasing the earthquake resistance of buildings. Based on these advances, certain hazards now can be corrected in post-1933 construction. Structures built between 1934 and 1959 should be evaluated for safe-exiting provisions and mechanical system performance. High-rise buildings built between 1959 and 1973 may need improvements in emergency exit provisions, fire suppression capabilities, utility safety, anchoring of furniture, and occupant safety in case of building "sway." Safety factors should also be checked in post-1973 buildings, although these are theoretically the safest.

Other corrections that could be required in response to a prediction include: the installation of wall anchors in some pre-1973 buildings, repair of defects in wood trusses, tightening of rod bracing systems, strengthening of suspended ceiling systems, evaluation of roof loads, anchoring of rooftop equipment, reanchoring of metal lath ceilings, and the installation of automatic gas shut-off valves. The recently revised elevator code should be approved so that its compliance date of 1980 may be achieved.

Special precautions need to be taken in order for vital structures to remain functional after an earthquake. Vital services in vulnerable buildings should be relocated or the buildings upgraded to meet seismic requirements. Hospitals and Emergency Headquarters should be fully prepared to withstand substantial ground shaking, to have alternate power sources, emergency communication facilities, and ample reserves of need supplies.

## Lifelines

An Earthquake Prediction Response Plan should provide special protection to the lifelines of the City. Disruption of transportation, communication, hospital, water, energy, or waste disposal systems will be a source of great inconvenience and possible danger to the citizens, and the loss of lifeline systems will substantially retard the recovery of the City following an earthquake. Lifelines should be upgraded as necessary, alternate facilities planned for when possible, emergency plans for the resotration of service reviewed, and emergency supplies stored.

A Response Plan should consider the supply of water as well as its distribution. Our energy supply should be protected by upgrading buildings which house power equipment and anchoring the equipment in place. Gas shut-off valves should be mapped. Emergency plans for the restoration of services should be reviewed, expanded where necessary, and readied for action.

When the specific details of a predicted earthquake are known, careful analysis of the earthquake resistance of transportation arteries and facilities (roads, bus and rail systems, airports) in the area would indicate which might need to be closed and which should be expected to remain functional. Alternate facilities could then be arranged.

Because of its geologic conditions and the high concentration of hazardous materials in the area, the Los Angeles harbor is extremely vulnerable to earthquake damage. Its problems need thorough study, and preparedness plans should be developed.

## Hazardous Facilities

Potential hazards to the City as a result of an earthquake include gas and petroleum pipelines, refineries, and storage tanks which could rupture and cause fires or explosions. Caustic, flammable, toxic, and radioactive materials would also be hazardous if they were to leak into the environment. Although much has been done to ensure seismic safety in newer installations, little has been accomplished in the upgrading of older facilities. Following an earthquake prediction, existing hazard abatement programs should be augmented or accelerated, exposure to hazards reduced, and priorities be directed towards areas most vulnerable to the predicted earthquake.

The failure of dams which are not earthquake resistant could cause widespread destruction and loss of life. Evacuation plans should be completed for all potential inundation areas. Effective procedures need to be established for rapid alerting of the public in the event of actual or potential dam failure.

## Emergency Preparedness

An earthquake prediction would enable Emergency Services to gear their respective plans to the specific characteristics (location, time, and magnitude) of an anticipated disaster. Following a prediction, each service should review, update and develop its earthquake response with special attention to maps, lifeline systems, hazard reduction, mutual aid agreements and Emergency Operating Centers. Public information on earthquake preparedness and self-help techniques will be important steps in augmenting the emergency forces, which will be concentrating on the major problem areas and unable to respond to many smaller emergencies immediately following a major earthquake.

## Legal Issues

Before an Earthquake Prediction Response Plan is implemented, certain legal issues should be answered. Unresolved questions include: (1) whether there is clear legal authority for the Mayor to initiate action in response to an Earthquake Prediction, (2) whether there is reasonable immunity from liability in taking or failing to take such action, and (3) the potential liability of the City in issuing evacuation orders, preparing damage maps, or taking certain other actions in response to a prediction.

Clarification is needed as to whether a prediction area could be designated a "disaster area" and qualify for appropriate State and Federal disaster assistance in advance of a major earthquake. Assistance would be needed to reduce the economic and social disruption, to supplant a loss of tax revenues, and to take precautions that would save life and property and facilitate recovery efforts. A clear policy statement or legislative action should be sought from State and Federal agencies before the first validation of a prediction.

## Coordination

For the most effective implementation of a Response Plan, efficient division of responsibilities among various levels of government needs to be established. An Earthquake Prediction Advisory Committee would be invaluable in advising the Mayor on the local significance of the predicted earthquake and the most appropriate warning and level of response. The Mayor and the Advisory Committee should coordinate their efforts with the Civil Defense and Disaster Board. Many City departments can take an integral part in prediction response, which will range beyond many of the traditional emergency response fields. The Departments of Planning, Building and Safety, Water and Power, Engineering and Public Works will be involved along with the Emergency Services. Recreation and Parks and Library Departments, and Housing, Senior Citizens and Mayor's Offices can participate in the dissemination of information. Liaison with the City Council and other local governments is essential, and a high degree of coordination will be needed among the numerous agencies and jurisdictions involved.

Coordination should also be developed with the private sector -- business and industry, financial institutions, volunteer groups, private utilities, etc. Citizens, too, must know what services they can expect from the City and where their own responsibilities lie.

## Funding and Staff

Existing City personnel from various departments should be utilized on a part-time basis for preparation of the Earthquake Prediction Response Plan and related public information programs. In addition, two full-time professionals would be needed for up to two years to organize and coordinate these efforts, and to provide necessary liaison with other agencies, jurisdictions and advisory groups. The Central Earthquake Preparedness Information Center would have a minimal year-round staff, which would be augmented when necessary with trained personnel on emergency loan from various departments.

Researchers in prediction-related fields could act as advisors in these preparations, and should be assisted and encouraged in undertaking research projects of import to the response plan.

# Chapter 1

## Introduction

The Task Force on Earthquake Prediction was established by Mayor Tom Bradley in November, 1976, "to explore and evaluate the range of possible City responses to an earthquake prediction and provide recommendations for alternative contingency programs that would be adaptable to the specific magnitude, urgency, and confidence level of a given prediction."

The Mayor's action followed increasing scientific and public interest in earthquake prediction, heightened by speculation and intensified research related to the "Palmdale Bulge", a regional uplift of the earth centered on the San Andreas Fault in Southern California. Although a reliable system of earthquake prediction will probably not be available for a decade or more, it is recognized that several predictions are likely to be made during the developmental stages of the science, and that resulting public concerns and business reactions may create a need for responsive action by local government.

Earthquake predictions, like earthquakes, can affect all sectors of the community as well as a wide range of governmental functions. Recognizing the breadth of the topics to be covered, the Task Force conducted much of its work in committees, concentrating its efforts in several major areas, including: emergency preparedness, lifelines, hazardous facilities, safety of buildings, legal aspects, governmental coordination, economic stability, social and psychological impacts, and public information. The principal results of the committees' studies are contained in Chapters 3 through 9 of this report.

# Chapter 2

# General Background

## HISTORIC BACKGROUND

In mid-February, 1976, the U.S. Geological Survey (U.S.G.S.) announced the discovery of a major uplift of the earth covering a large area that is centered approximately on the San Andreas fault in Southern California. Because of its large size and its alignment along a segment of the San Andreas fault that is known to have been "locked" since Southern California's last great earthquake in 1857, scientists expressed concern that the "Palmdale Bulge" or "Southern California Uplift" may foreshadow the next great earthquake in the region. As a result, Federal, State, and University scientists expanded existing programs designed to develop earthquake prediction capability, intensifying and broadening their monitoring of the earth in this area.

In mid-March, 1976, the U.S. Geological Survey noted the potential significance of the Southern California Uplift, and issued a warning:

"If an earthquake similar to that in 1857 occurred today in the region about 30 miles north of Los Angeles, the probable losses in Orange and Los Angeles Counties alone are estimated as follows:

40,000 buildings would collapse or be seriously damaged.

3,000 to 12,000 people would be killed.

12,000 to 48,000 people would be hospitalized.

$15 to $25 billion in damage would occur.

Failure of one of the larger dams could leave 100,000 homeless, and tens of thousands dead."

The U.S.G.S. further indicated that if data supporting a prediction became available, they would evaluate the evidence and transmit their findings to the Governor.

Following the U.S.G.S. warning, the State Office of Emergency Services announced to key local officials that there was "a renewed sense of urgency in preparing for the large earthquake that someday inevitably will occur in this region."

In April of 1976, James Whitcomb, a professional seismologist, issued a trial prediction in the form of a "hypothesis test" which projected a Magnitude 5.5 to 6.5 earthquake for an area similar to that hit by the 1971 San Fernando earthquake. Although the prediction was not directly supported by the California Earthquake Prediction Evaluation Council (CEPEC), the Council indicated that "the data are sufficiently suggestive of such an increased probability as to warrant further intensive study. . ."

Soon thereafter, the realization that Chinese scientists had successfully predicted a major earthquake in February, 1976, thereby saving tens of thousands of lives, gave scientists in the field of earthquake prediction added impetus and increased expectations of eventually developing successful predictions.

It now seemed quite possible that some of the first American earthquake predictions could come from the highly-monitored Southern California area.

## STATUS OF THE SCIENCE OF EARTHQUAKE PREDICTION

The evolving science of earthquake prediction is likely to produce a number of scientific predictions over the next decade. Although based on scientific evidence, they will have varying degrees of precision and reliability, and will receive differing assessments from the scientific community. Even the predicting scientist may assign a relatively low "confidence level" to his or her prediction. These predictions may nevertheless allow some appropriate preparations to be made in anticipation of the possible earthquake, with potential savings in life and property. The early predictions will undoubtedly elicit a great deal of public interest and concern.

The following discussion, provided by a seismologist member of the Task Force, offers some additional insights on the prospects for earthquake prediction:

"Most seismologists are reasonably confident that someday we will be able to predict earthquakes with a significant degree of reliability. We have not yet achieved this goal. In fact, the degree of optimism today is somewhat less than it was two or three years ago. At that time, it appeared that seismic velocity changes in the earth's crust preceded earthquakes in a systematic and measurable way. This phenomenon has subsequently been shown to be less dramatic and universal than was originally thought. Nevertheless, clear physical precursors of various types do precede many earthquakes, and some of these premonitory signals have been utilized for several successful predictions in various parts of the world. American seismologists who recently visited China agree that the Chinese were indeed successful in predicting the major 1975 Haicheng earthquake 5½ hours before the event, thereby saving many lives. Earlier, less precise warnings had identified the area as one of special concern over a period of several years. To date, however, the number of false alarms and failures far exceeds the number of accurate predictions -- in China as well as the rest of the world.

"In this country, most seismologists would probably agree that it will be at least ten years before we have the capability to predict earthquakes precisely and consistently. Successful predictions most likely will be contingent upon our gaining a much better physical understanding than we now have of the earthquake-rupture process at depth in the earth's crust. Such is the purpose behind our very widespread current studies of the Southern California uplift (the so-called "Palmdale Bulge"), as well as intensive studies of the numerous small earthquakes that occur every day in the Southern California region.

"The period during which we are developing an earthquake prediction capability will be a difficult one because we will almost inevitably experience some significant failures and false alarms; this is the very nature of the application of the scientific method. Maintaining public support for the continuing research effort during the development period will be a major challenge. Initial predictions may be of such low confidence levels that it will be difficult to recommend how public agencies should respond, if at all. Nevertheless, it is realistic to envisage that we will eventually achieve a capability of routine, high-confidence-level predictions with time-windows narrow enough (e.g., within a few hours or days) to allow meaningful responses of emergency forces.

"Even if scientists are unable to predict earthquakes routinely with great accuracy for a decade or more, it is important to recognize that some scattered predictions will be forthcoming during the intervening years. Although some of the early predictions may be generalized, controversial, and difficult to respond to, public agencies cannot afford to wait for a fully developed prediction capability before formulating response plans. Now is the time to worry about developing programs for constructive response. Clearly, the City must be prepared with a range of responses suitable to a wide variety of predictions."

## COMPONENTS OF A PREDICTION

Although scientists have been making general earthquake predictions for many years (e.g., "a major earthquake will occur in Southern California within the next 100 years"), the prospect of more specific and reliable predictions has led to the formulation of standards for the requisite information that should be elucidated in any prediction. The four major components are:

Magnitude (Richter magnitude at the earthquake focus)

Location (expected vicinity of the epicenter)

Time (preferably including the lead time before the event will occur and the time window within which it could occur)

Probability (that the event will occur as predicted. Until there is an adequate statistical basis for determining probability, scientists will probably prefer to indicate a confidence level instead.)

Some scientists would also like to see a fifth prediction component -- predicted ground motion, including peak acceleration. This additional component would facilitate more accurate estimates of earthquake intensity.

## ISSUING AND EVALUATING A PREDICTION

### WHO WILL RELEASE PREDICTIONS?

An earthquake prediction can come from scientists at public or private universities, from State or Federal scientists, non-affiliated scientists, or individuals using non-scientific or semi-scientific prediction techniques. Because of this variety of sources as well as the open approach to scientific research that exists in western societies, a prediction will become public knowledge and be broadcast by the news media very quickly. Experience has demonstrated that a possible prediction is likely to be uncovered by the press unless it is announced to the public promptly. Initially, public response to a prediction will depend on the credence and publicity given to that prediction by the news media.

### EVALUATION OF A PREDICTION

Both the State and Federal governments have set up mechanisms for evaluating earthquake predictions. Scientific predictions of damaging earthquakes affecting the State of California are reviewed by the California Earthquake Prediction Evaluation Council (CEPEC), a panel of recognized earth scientists. The Council will evaluate the scientific basis for the prediction and determine whether it merits verification. CEPEC reports its conclusions to the Governor and the State Office of Emergency Services. It is generally the policy of the Council to make its deliberations open to the press and public, and to announce its findings immediately. If a prediction of a damaging earthquake is validated by the CEPEC, either the Governor or the Office of Emergency Services will most likely issue an official warning, with some initial recommendations on measures that could or should be taken at State and local levels to prepare for the predicted earthquake.

If a prediction arises within the Federal scientific establishment, it will be submitted to a review committee which advises the U.S. Geological Survey*. Federal predictions may or may not become public knowledge before the federal committee has completed its evaluation. The U.S.G.S., which issues all federal warnings of impending geologic hazards, will probably submit any warning of a California earthquake to the Governor and perhaps to local leaders such as the Mayor. Whether the federal warning is announced by the U.S.G.S. or by the State, the warning is likely to become public almost immediately. CEPEC may then wish to provide an additional review of the Federal prediction of a California earthquake.

## POSSIBLE PREDICTION SCENARIOS

Predictions during the next decade could involve a wide range of variables with respect to credibility of source, lead time, specificity of detail, and confidence level assigned to it. Several possible scenarios are described below. They raise some provocative questions relating to the potential response of the City, and contingency plans should consider appropriate responses to the following possibilities:

- The sequence of events most commonly envisioned by earth scientists deals with a progressive refining of prediction details over several years. The first stage would be an announcement that the area is being designated for intensive study of possible earthquake precursors. Such an announcement could be based on indications of a possible earthquake but inadequate data for any specific predictions. (It should be noted that the area of the Southern California Uplift is already in this pre-prediction stage.) The next stage could be a general prediction of a possible earthquake several years hence (perhaps two to five years in the future), with a relatively large time-window (several months to a few years) and only a general indication of the location and magnitude of the earthquake. A high probability or confidence level is not likely to be assigned to the prediction at this stage. Over the subsequent years scientists would attempt to refine the prediction by collecting additional data relating to the anticipated mangitude, time window or location of the earthquake, and perhaps by raising the confidence level. It is also possible that the prediction could be rescinded if new data is contradictory or fails to follow the anticipated pattern. As a final stage, a short-term prediction that an earthquake is expected within a few hours to several days might be issued. At this point the confidence level assigned to the prediction may or may not be increased, although in an ideal situation the probability assigned would be 70 percent or better. At each stage of refinement the predictions would presumably be evaluated by CEPEC. How does the City respond to a changing prediction, or even to the cancellation of a prediction?

- A valid scientific prediction is affirmed by CEPEC. Scientists assign it a low confidence level (e.g., 25%) that stays low throughout the prediction period. How do we respond to a low-confidence-level prediction of an earthquake -- one that probably will not happen?

- A valid scientific prediction of a relatively high confidence level remains very ill-defined as to specific time and place (e.g., somewhere in Southern California during the next year). How can a specific locality such as Los Angeles respond to such a prediction, if at all?

- A prediction is discredited by CEPEC, but is strongly defended by a scientist or a group of scientists with sufficient credentials to be considered legitimate by the public and news media. How do we react to strongly split opinion among the scientists, even if the weight of opinion is predominantly on one side? (A strongly split vote on CEPEC itself is certainly not out of the question).

- A short-term sequence of allegedly premonitory events, such as a 24-hour burst of magnitude 5 earthquakes on the San Andreas fault at Palmdale, happens so rapidly that no scientific consensus is possible. Nevertheless, several scientists publicly express concern about the possiblity of an imminent earthquake. Should the City be in a position to react even in the absence of a scientific consensus or a full report from CEPEC?

- A prediction that is unanimously discredited by the scientific community gains wide acceptance via the news media and rumors. Should the City respond at all to this kind of situation? Should the scientific community react more aggressively to discredit allegedly "unscientific" predictions? Can we somehow avoid the syndrome of "the underdog vs. the (scientific) establishment?"

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* Present plans call for the formation of a National Earthquake Prediction Evaluation Council (NEPEC) to be composed of university, independent, and U.S.G.S. scientists. Preliminary coordination procedures for the state and federal councils have already been worked out.

## POTENTIAL EFFECTS OF AN EARTHQUAKE PREDICTION

Most Californians are familiar with the types of damage and disruption an actual earthquake can produce. Only recently has it been recognized that the credible prediction of an earthquake could itself produce widespread disruption whether the earthquake occurs or not.

Studies released over the past few years indicate that although an earthquake prediction would provide the opportunity for significant saving of life and property, a series of social and economic changes -- to the potential detriment of the stability of the area -- could also result.

A major NSF-sponsored study on the Socioeconomic Impact of Earthquake Prediction* used extensive interviews with seismologists and representatives of news media, government, business firms and the general public to determine their reactions to a hypothetical earthquake prediction,

The hypothetical prediction had four phases spanning three years time. The phases were similar to our first scenario (preceding section), with increasing specificity and confidence levels at each phase: 1) In the first phase the announcement that the local area has been designated for intensive earthquake study is followed by independent statements from two reputable scientists that the data suggests a 25 percent probability of a damaging earthquake in approximately three years. 2) A year later the U.S. Geological Survey releases an official prediction with a 50 percent probability of a Magnitude 7 (or greater) earthquake to occur two years from that time. 3) About six months from the target date the prediction is refined to an 80 percent probability, with a specific one-month time window and a magnitude of 7.1 to 7.4. 4) About a month before the target date the prediction is further refined for a 7.3 magnitude and a one-week time window within which the earthquake is expected to occur.

This prediction scenario was then augmented in succession by incorporating the results of interviews, first with the media and government representatives, and then with business leaders and the general public. The results of the study provide significant insights on the type of reactions a longer-term prediction of a highly damaging earthquake could produce, although the magnitude and extent of the reactions may not be as great in some respects. The study documented major reactions to the hypothetical prediction in the following activities:

- Construction: Most new construction in the "target" area has ceased eleven months after the first U.S.G.S. announcement. Immediately after the first official prediction, planned construction within 25 miles of the predicted epicenter has not begun, although existing work continues.

- Lending: Lending institutions operating in the "target" area reduce by as much as 80 percent the number of loans they are making in the area after the first prediction. New loans still being made require higher down payments, fewer people can qualify for loans, and property becomes difficult to sell.

- Population Movement: Eleven months after the first U.S.G.S. announcement, population growth in the "target" area has slowed and far fewer new businesses are opening now than a year ago. One year after the first official prediction, many people are considering moving out of the area permanently; within three months nearly eight percent have done so. Within the year before the target date more area residents begin to make plans to leave at least temporarily, but about 50 percent still plan to stay. At this time, a few national business firms move permanently. Immediately before the expected earthquake, nearly 60 percent of the population have left the area (ten percent have left permanently). One-fourth of the temporary evacuees have moved into shelters set up by the Red Cross; the others have left the area for vacation trips or to stay with relatives or friends.

- Taxes: Seven months after the official prediction, there is a slight decrease in city sales tax revenues and city officials begin to plan for the necessary cuts in services. Approximately one year before the target date, more than half the property owners in the area request lower assessed valuations of their properties. Property taxes paid to local governments fall off slightly, with a few property owners withholding all payments in protest against the decrease in city services and others paying only part of their assessments. There is only a very slight drop in mortgage payments, however. Three months before the expected earthquake, local sales and property tax revenues have declined appreciably.

- Employment: Unemployment in the building trades approaches 80 percent four months after the official prediction. General unemployment gradually rises as the decrease in business activity forces many firms to lay off employees.

- Retail Sales: One year after the first prediction, evidence indicates that one-fourth of all families are postponing large purchases. During the year before the expected earthquake retail sales continue to drop as more people in the area decide to delay major purchases; only about 40 percent of the population maintain their usual buying patterns.

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* The study was conducted by a research team from the University of Colorado and Colorado State University and headed by Eugene Haas and Dennis Miletti. Interviews were conducted in both Southern and Northern California and the results were released in December, 1976.

- Business Closures: Nine months before the expected earthquake, one-fourth of the small businesses in the area have either declared bankruptcy or sold out due to the economic pressures. Many other businesses close down completely in the two weeks preceding the predicted earthquake.

It should be pointed out that the hypothetical prediction scenario represents both a high probability (80%) prediction and a long lead time for the various reactions to set in. (In another scenario, with a shorter lead time, the same research team detected very few adverse reactions.) In spite of ingenious efforts to simulate a real-life decision-making situation, the people interviewed were hypothesizing about a condition which was markedly different from anything in their past experience. Business leaders based their decisions on factual estimates, such as number of people leaving the area. Error in these approximations could have produced unrealistic decisions. Furthermore, the researchers emphasize that their findings will come true only if there is no effective program to forstall and counteract adverse developments. When their study was conducted, neither local nor state governments were prepared to monitor the various reactions or to implement appropriate measures that could have offset some of the more extreme responses.

Despite the dire consequences of the prediction as detailed above, the researchers felt strongly that, in the long run, predictions of this type will be of great benefit to society. A prediction could be the "dominant driving force" in increasing the scope, intensity and specificity of efforts related to preparedness for the earthquake, as well as in planning for relief, restoration, and reconstruction following the earthquake. They also noted that the social and economic reactions documented in the study had the beneficial effect of reducing the degree to which life and property would be endangered by the earthquake.

# Chapter 3

# Social and Psychological Impact

## BACKGROUND

The major consequences of an earthquake prediction will be determined by the individual and collective reactions of the affected community. Any governmental action will be influenced, in large part, by impressions of what the public response will be. Therefore, City officials should know what psychological responses to expect, what the social needs of the community will be, and what actions would effectively serve the evolving needs of the community during the prediction period.

A wide range of reactions to earthquake prediction is anticipated. Responses may run the gamut of possibilities and will vary according to age group, cultural heritage, and the quality of relationship an individual has with his family and society.

Local receptivity to the idea of a future damaging earthquake may be influenced by a widespread cultural recognition in California that "the big one" can occur at any time and may even be overdue. Few extreme reactions are expected from the populace as a whole, although indifference or grave concern may be expressed by some individuals or some segments of the population. Panic, in terms of an immediate reaction which stimulates drastic decisions in the short range, is unlikely, despite the tendency for cinematic dramatizations to exploit this theme. Widespread apathy, a total lack of reaction, is also unlikely, for underlying anxiety gradually will arouse most citizens to some form of action. Many people will, however, demonstrate a "normalcy bias" by choosing to follow normal, familiar routines in response to anxieties created by the prediction. This may manifest itself as a predisposition to hope, a tendency to normalize events, postpone action, or anticipate survival. Many people will assume they have a better concept of the truth than they actually do. The "normalcy bias" will tend to produce inaction, especially if a more appropriate response to the prediction is unclear or appears to be difficult.

Much of the individual response to a prediction will be predicated on self-interest, the individual's perception of rational response, and the pursuit of individual priorities, either for preservation or indulgence. Self-interest will often be an initial and sometimes a continuing motivation. This is not necessarily a negative prospect. In fact, local officials may find it advantageous to increase their understanding of self-interest, improve its quality, and cooperate with those self-interest reactions that enhance stability in the community. These reactions may occur in stages, progressing through an increasingly broader circle of self-interest:

1. Self-preservation.
2. Family, loved ones, relatives, close friends.
3. Economic survival, livelihood, work, income.
4. Material object preservation.
5. Immediate neighborhood.
6. Social and organization contacts.

Unless they are carefully guided, reactions in the larger circles of contact, particularly in the realm of economic survival, could result in economic costs and social disruption greater than similar costs of a real earthquake. (See Chapter 4.) Unlike a disaster, a long or medium range earthquake prediction does not lend itself to spontaneity. The advance warning allows time for self-interest to enter into contemplation, hedging, or planning, particularly in decisions relating to finances, family, income-employment and material objects. In such situations, individuals with a vested interest in the community (leaders, business people, home owners, etc.) may be important stabilizing influences.

The announcement of a prediction will not necessarily incline the public to give up personal preferences for action in compliance with governmental programs. If the populace believes they have legitimate reasons for noncompliance, government orders will be ineffectual. Particularly if they believe the consequences of a prediction are disadvantageous, potential victims of a predicted earthquake are likely to act on their own, perhaps contrary to the plans of governmental agencies, without waiting for advice or offers of assistance.

## ISSUES AND RECOMMENDATIONS

### ISSUE #1: Announcing the Prediction Response

The Mayor's Office is not likely to be the first to announce a prediction, or to be the controlling center for initial information. Follow-up announcements by the Mayor's Office have the handicap of competing with the more spectacular primary stories. Moreover, the office will have to contend with a public and media reaction of "already knowing about it."

Recommendation: The Mayor's Office can elicit the confidence of the people by demonstrating well-informed leadership and promptly announcing a local response plan following the verification of a prediction by the California Earthquake Prediction Evaluation Council (CEPEC). Progress towards rational acceptance and productive response is more likely to occur if the Mayor's Office specifically supports the prediction and initiates productive action to protect and assist the community.

### ISSUE #2: Responding to a Prediction Before CEPEC Reaches a Decision

Past experience indicates that predictions are likely to be revealed by the news media before they can be submitted to CEPEC for evaluation, and that there will be an additional lag time before CEPEC can complete its evaluation.

Recommendation: When a prediction is made public before CEPEC has issued its findings, the Mayor and City agencies should be sufficiently prepared that the Mayor can announce that the City is ready to take appropriate actions once any prediction is validated.

### ISSUE #3: Responding to an Unconfirmed Prediction

It is possible that CEPEC will fail to support a scientific prediction that continues to be defended by one or more scientists with widely accepted expertise. Disagreement within the scientific community about the validity of a prediction will heighten public skeptism and anxiety.

Recommendation #1: If local government is faced with a highly publicized prediction without consensus or with a rejection from the scientific community or CEPEC, a low-level response program could be announced. Regardless of the validity of a prediction, this type of plan would allow concerned citizens and organizations to take positive actions that would allay their fears and better prepare them to withstand *any* future earthquake.

Recommendation #2: The low-level response could also be augmented with limited implementation or acceleration of seismic safety programs by the City, if the Mayor's advisors determine that there could be merit to the prediction.

### ISSUE #4: Responding to Non-Scientific Predictions

Popular concern and acceptance of a prediction will not necessarily increase in direct proportion to the scientific validity of the prediction. Questions about the credibility of a scientific prediction may increase public interest in non-scientific predictions as well as scientific ones. A recent study of non-scientific earthquake predictions conducted by the U.S. Geological Survey concluded that their general validity is *less* than if predictions were made by random chance.

Recommendation #1: Scientists will make clear which predictions they consider valid and which invalid, but this is not the appropriate time for the City to launch a campaign to wean people away from nonscientific views.

Recommendation #2: When nonscientific predictions are widely reported in the news media and public concern is aroused, the City should not reinforce the prediction itself, but can provide specific information on earthquake preparedness that would allow concerned individuals to become better prepared for *any* earthquake.

### ISSUE #5: Achieving Credibility

Until earthquake prediction and prediction response have become accepted procedures comparable to flash flood watches and hurricane warnings, public skepticism of the process may lead to a substantial reduction in the public benefit that would otherwise be derived from a prediction.

Recommendation #1: The City should not try to magnify the significance of a prediction, but should attempt to clearly assess its significance to the local area and carefully select a slate of response actions that are realistically geared to the magnitude, location, timing, and probability of the predicted event. The significance of the prediction's parameters should be clearly and repeatedly explained to the public.

Recommendation #2: In evaluating the appropriate prediction response, seek the advice and support of community leaders, including those from scientific, religious and social services communities. They could also be invited to participate in the announcement of the City's response plans for that prediction.

Recommendation #3: Work for the support and concurrence of the County Emergency Preparedness Commission, which is comprised of representatives of the City, the County, and other local jurisdictions.

Recommendation #4: As an aid in building confidence, before any prediction is issued arrange a series of meetings with opinion leaders to explore their views on the responsibility of the Mayor's Office in responding to a prediction. (See Chapter 8, Issue #4.) Discuss various kinds and levels of action that may be taken. Distinguish between appropriate responses to a credible prediction and a low-probability or "pseudo" prediction. When a specific prediction response is to be announced, seek the cooperation of these leaders again. This group should include representatives of:

News media
Major political organizations
Ethnically segregated communities
Seismologists and geologists
Religious leaders
Leading businesses, or business associations
Unions
Civic associations
Professional associations

To gain further insights, request a resume of what each organization would be likely to do in the event of an earthquake prediction.

Recommendation #5: Major economic decision makers could be a crucial group with whom to seek cooperation. Their perception of prediction and the impact of their decisions could have an effect on community survival. If prediction warnings have been issued from quarters other than the Mayor's Office, the economic community is likely to proceed with their own interpretation and planning. That would remove the initiative from the Mayor's Office and trigger a game of "catch-up" or rectification unless cooperative discussions are held with this community before a warning is issued. The City should sponsor seminars with business community leaders following a prediction. In addition to the inherent advantage of gaining credibility for a prediction, these discussions would increase confidence in the City's ability to cope with the impending disaster.

### ISSUE #6: Controlling Anxiety

A period during which a prediction and warning are in effect may be more anxiety-producing for some people than disaster itself. The clearer and more certain the sense of where and when one is in danger and where and when one is safe, the less prone people are to attacks of uncontrollable anxiety. Concerted and repeated training in how to be relatively safe in an earthquake is reassuring. Anxiety is more easily subdued if individuals understand what actions can be taken and are able to do something in preparation for the coming earthquake.

Recommendation #1: In advance of any prediction, information should be prepared on procedures for making the home, working environment, and travel routes safe. This information should be as specific as possible.

Recommendation #2: Announcements regarding hazardous buildings should also be accompanied by general information on the types of buildings that are inherently resistant to earthquake damage. For example, the vast majority of one- and two-story wood-frame buildings, such as those widely used for suburban residences, are highly resistant to collapse in an earthquake.

Recommendation #3: A centralized clearing house for information that can relieve and clarify psychological and social anxieties should be prepared for activation when a prediction is announced. (See also Chapter 8, Issue #2.) This has proven to be one of the most useful governmental projects in natural disaster situations.

Recommendation #4: The earthquake information center should also function as a rumor control center as a means of encouraging stability of information and reaction.

Recommendation #5: Once a warning is issued, encourage the development of a program of volunteer activities, perhaps augmented by a neighborhood "warden" network. The network or neighborhood could be used to create a framework for emergency mutual aid following the earthquake, to transmit essential information to many who might otherwise miss it, to identify people whose problems require special attention, and to involve people in neighborhood support groups.

### ISSUE #7: Dealing With Denial

Anxiety can produce a denial of the threat in order to remove the cause of worry. A certain amount of denial will be caused by fear of business losses if the prediction and warning are taken seriously. Some populist and minority groups and other population segments may express anti-establishment and anti-scientific attitudes in their suspicion of the motives of scientists and public officials. Most of these responses must be understood more as ambivalence than as outright disbelief.

Recommendation: Scientists and public officials should deal with responses of disbelief by emphasizing the actual nature of the danger rather than engaging in attacks on the disbelievers that can polarize the community.

### ISSUE #8: Dissatisfaction With Local Government

Local government, the most conspicuous level of authority for responsibility and complaint, will be the object of intense reactions during the prediction period. Initially, people may be pleased with a job well done and grateful for the foresight provided by a prediction. But a long lead time between prediction and earthquake is certain to stimulate innumerable questions and proposals, some of which may be derogatory if citizens perceive local government action to be inadequate. This questioning and proposing occurs because (1) there is time to develop a critical assessment of government response, and (2) there is widespread belief that individuals alone are not able to resolve the massive problems associated with an earthquake. As a result, residents of the City will expect governmental agencies to provide answers and broad solutions, whether or not the authority, funds, resources, or consensus is available to permit these agencies to satisfy all queries and suggestions.

Recommendation #1: Lines of communication between City Hall and the general public should be kept open during a prediction period, and the City should demonstrate a sincere interest in receiving and responding to information on the developing needs of the public.

Recommendation #2: Viable Public Information and Self-Help programs can increase self-confidence and self-reliance, prodding people to assume greater responsibility for their own welfare.

### ISSUE #9: Educating the Public

If a prediction is vague as to exactly where and when a particular earthquake will occur, public reaction from that segment of citizenry with vested interests in the community could become intense. People will demand more precise information on the significance of a prediction and the potential effects of the predicted earthquake, as well as measures that can or will be taken to protect their welfare.

Recommendation #1: In announcing a prediction response, clarify these factors:

-Probablity, likelihood, reliability of prediction.
-Magnitude and intensity.
-Lead time as well as time-frame of earthquake.
-Region of anticipated impact.

Also provide, as soon as practicable:

-Damage maps, showing the projected distribution of light, moderate and heavy damage throughout the City.

Recommendation #2: Present recommendations in terms that reinforce personal self-interest, cooperation, and community interest. These features should be expressed in statements of what the Mayor's Office advises the public to do in the public's best interest.

Recommendation #3: Evolving Education: As interest and awareness of the earthquake prediction topic grows, the level of information and knowledge will change. Interest and knowledge may become more sophisticated. Consequently, the Mayor's Office will want to be prepared with phased educational materials, each increment treating the topic in an increasingly more professional manner. (For further details, see Chapter 8.)

Recommendation #4: Earthquake Side Effects: Utilize the occasion of a prediction to educate the public about secondary effects of an earthquake such as: fresh water contamination, disruption of water supply, leaking gas, uncertainty of sewage lines, broken electrical connections, chemical leakage, etc.

### ISSUE #10: Mobilizing Public Action

The competing demands of daily activities, combined with the tendency of many people to avoid anxiety by following normal routines, will tend to limit the extent of productive preparations that would be taken by the public. The potential savings of life and property derived from knowledge of the prediction will thereby be reduced. Special measures may be necessary to motivate the people to take appropriate precautions.

Recommendation #1: When an earthquake warning is announced, the public should be instructed to take actions which will increase general preparedness for any earthquake. Encouraging people to be self-reliant, such instruction will engage them in advance planning. They will begin to act on long-range intentions as a time frame is established by the prediction date. Thus, prediction can be a stimulus for financial planning, correcting interior hazards, and upgrading buildings as time allows.

Recommendation #2: The independent behavior of citizens through customary social structures will relieve some of government's responsibility for recommending courses of action and solutions to the consequences of a prediction. The City should assist and encourage established organizations and informal communities to provide productive solutions and responses in their own areas of influence.

Recommendation #3: Management personnel could promote effective action within their own companies or agencies. They should become familiar with response plans and maintain a state of readiness. The Mayor's Office should make prediction planning material available to them.

Recommendation #4: Research indicates that attempts by governmental agencies at deliberate control of the public in anticipation of predicted natural disasters have not been very successful and can undermine respect for governmental competence and authority. Therefore, it would be wise to stress cooperation with the public in developing self-sufficiency rather than rigid (absolute) control.

### ISSUE #11: Providing for Children

The education, preparation, and care of children are important aspects of an earthquake prediction response plan.

Recommendation #1: In advance of an actual prediction, the Mayor's Office should prepare a program and materials suitable for children and parents, in anticipation of a need which is likely to arise. The survival and psychological stability of the family will have a high priority for many people.

Recommendation #2: Elicit the participation of the school district in preparation of the response plan, and encourage special in-school programs to help meet this need.

### ISSUE #12: Providing for the Handicapped, Aged, and Institutionalized

Recommendation: The Mayor's Office should consider and have available recommendations and procedures for aiding, coping with, or facilitating those individuals with restricted ability to affect their own welfare. Although the handicapped and aged come readily to mind, there is a pressing need to assist individuals locked in secure institutions. They will be even more entrapped if an actual earthquake occurs.

### ISSUE #13: Relocation and Evacuation

Where imminent hazards can be identified, it may be necessary to advise occupants of a building or neighborhood to relocate temporarily for the immediate time window of the predicted earthquake. In certain cases, full evacuation of selected buildings or limited areas might be ordered. Shelters have not been very effective in attracting and holding citizens in anticipation of a predicted disaster. Past experience indicates that most people evacuated at the time of an emergency will prefer to find refuge with relatives or friends whenever possible.

Recommendation #1: The City should assist in finding relocation housing for persons and families displaced from hazardous structures as the result of prediction warnings. For those whose relocation with family and friends is not practical, established organizations and volunteer foster families could "sponsor" displaced families or individuals. Public relocation centers should be used only for very temporary housing of people in transition. The placement of relocated families should attempt to maintain proximity to accustomed work, school and community centers, whenever possible.

Recommendation #2: Additional temporary housing will probably be needed after the earthquake; arrangements should be made before the earthquake occurs.

Recommendation #3: Advance plans should be made for the permanent relocation of as many as 10,000 to 50,000 people who may not be able to return to their former homes following the earthquake.

### ISSUE #14: Using Shelters

Past experience indicates that shelters do serve as focal points when they function as information centers or training locations for individuals and groups. Providing a reasonably controlled environment for personal interchange of views about earthquakes and predictions between neighbors, they can increase the sense of neighborhood and community, and stimulate the formulation of locally oriented preparedness programs.

Recommendation: Shelters set up in anticipation of a forthcoming earthquake could operate prior to the earthquake as community information centers and meeting areas, and promote greater preparedness within the community. Local familiarity with the centers would promote their more effective use in an earthquake's aftermath.

### ISSUE #15: Studying the Problem

A complete analysis of the psychological and social impacts of earthquake prediction is a complex project. Because of the scope of the topic, the subject deserves further research. An organized research program could be undertaken by, or in cooperation with, university researchers and/or professionals in the field.

Recommendation #1: To facilitate the formulation of public announcements and actions, a three-phase study could be conducted to ascertain the correlation between self-interest responses and community stability goals.

a. Phase 1: Conduct a free-ranging probe of what individuals and organizations are likely to do without any official guidance.

b. Phase 2: Independently ascertain those effects or actions that would be desirable in achieving community stability.

c. Phase 3: Based on an integration of "a" and "b", rephrase public announcements, emphasizing what the individual can do: recommendations can be geared to the self-interest of the individual as well as the stability of the community.

Recommendation #2: Develop a plan using the four variables (probability, magnitude, location, date) and representing the wide variety of circumstances that would characterise a prediction. This system could facilitate planning for different levels of response related to the specific characteristics of the prediction.

Recommendation #3: Simulation: Systems Analysis. Research is needed to develop a simulation exercise which would cover the entire lead time for a series of prediction announcements. This type of drill would be helpful to responsible government people and key representatives of the public. It would accomplish the following:

a. Provide experience and allow for adjustment in a prediction response plan.

b. Revive and enliven an awareness of the ramifications of a prediction that might otherwise be forgotten as government officials cope with more immediate problems while awaiting the disaster.

c. Capture the interaction and dynamic behavior of different components of an earthquake prediction response system.

Recommendation #4: Simulation: Preplan. To improve existing prediction response plans, a study should be conducted to outline a simulation exercise that could be practiced annually in September. Utilize simulation for an imaginative examination of possible plans:

a. Original ideas are less likely under stress.

b. Provocative scrutiny of the topic could elicit some novel proposals.

# Chapter 4

# Economic Stability

## BACKGROUND

Although the developing science of earthquake prediction holds promise as a life- and property-saving measure, a credible prediction may cause severe economic repercussions in the area of the predicted quake. If not held in check, these repercussions might be considerably more severe than those caused by the earthquake itself. The degree of severity will depend on: the credibility of the prediction, the projected magnitude of the earthquake, the amount of lead time, the protective laws in effect, and the extent to which the public can be 1) educated about the actual risks involved, and 2) motivated to act responsibly.

If the prediction is believable and the magnitude siseable (8.0+ on the San Andreas fault or 6.0+ on one of the numerous faults within the metropolitan area), the economic repercussions could be severe. The longer the lead time, the greater the possibility of economic and social disruption.

For a prediction to be productive rather than counterproductive, local governments in a potential "target" area must formulate an adequate prediction response plan and find the means to finance its implementation before a warning is issued. Planning to counteract negative reactions to a prediction adds another dimension to an already large task.

Following a credible prediction, the state could provide special technical and financial aid to a "target" community if the State Legislature would appropriate the necessary funds.

At present, the federal government has little responsibility for what happens in a community prior to a disaster. However, if Congress becomes convinced that the impacts of an earthquake prediction are so extensive that state and local resources cannot cope with them, they may be persuaded to provide assistance.

## ISSUES AND RECOMMENDATIONS

### ISSUE #1: Economic Decisions

Important economic decisions will be influenced by a credible earthquake prediction. Business firms whose facilities, equipment, investments and personnel are geographically dispersed will have fewer concerns and problems than strictly local companies. Because their overall financial structure is less dependent on what happens in Southern California, these organizations are less threatened by potential disasters. Also, since their economic decisions are often made years in advance, they are more likely to be affected by a prediction with a long lead time than by a short lead time. A warning of three or more years, however, may result in a flight of capital when these larger companies divert investments from the target area, a tendency which might persist until the predicted earthquake occurs or the prediction is no longer credible. On the other hand, if key facilities (such as a computer system) are located in the "target" area, the threat of an earthquake is very real. Financial plans, future investments, and proposed new construction may have to be reassessed. When time permits, certain business interests may migrate out of the area.

Some local businesses will benefit from a credible earthquake prediction. They can reduce potential losses by reducing inventory or by providing special protection to equipment and stock. Facilities may be temporarily relocated, and marginal businesses may be closed. Investment and construction plans may be delayed or altered.

Immediate financial effects will include a delay in purchases and a simultaneous increase in money going into savings accounts, a decrease in money available for loans, and a flight of capital away from the area. Rather than face the problems of absenteeism, firms may encourage employees to take vacations during the prediction time window.

While these responses will benefit the businesses involved, their effect on the community may be generally unfavorable. The area may be hit by problems of rising unemployment, as well as declining sales and property values which would lead to declining tax revenues, despite the need for increased public services.

Recommendation #1: The Mayor should take the lead in educating the public to the real dangers involved in both earthquakes and earthquake predictions. Studies show that, in a variety of wartime and peacetime disasters, an informed public has resisted the urge to panic and has acted responsibly.

Recommendation #2: Business establishments which demonstrate civic responsibility in responding to an earthquake prediction should be given public recognition.

Recommendation #3: Key spokesmen from the private sector should be invited to participate in industry study groups. Representatives from insurance companies, lending agencies, building industries, etc., should be included. They should participate in the development of a coordinated earthquake prediction response plan and appoint persons to serve as a liaison between the private sector and local government.

Recommendation #4: A joint government and private commission could perform a valuable service in monitoring the economy in the threatened area to 1) detect early signs of change, and 2) offer advice to government, business, and labor organizations as needed. Based on their assessment of a specific set of circumstances, this group could recommend whether to sustain a particular community or allow and encourage the orderly outflow of capital and population. Without such a decision, contradictory plans could bring economic chaos to a target area.

Recommendation #5: To allay the fears of the business community, the Mayor should seek legislation which would:

a. Permit the anticipated earthquake site to be designated a "disaster area" once a major prediction is verified and before the actual earthquake occurs, thereby freeing federal funds for preventive actions. (See Chapter 5, Issue 11.)

b. Establish a national program of Natural Catastrophe Insurance. (See Issue #4 for details.)

c. Guarantee the loans and obligations of lending institutions in areas of predicted earthquakes. (See Issue #5.)

## ISSUE #2: Employment

Unemployment in some sectors will certainly increase after any credible prediction, regardless of the lead time. When the lead time is short, employers in hazardous buildings will probably close down or substantially curtail operations. If they don't, employees may refuse to come to work. Even those employers housed in relatively safe buildings may close or curtail their operations temporarily with layoffs or forced vacations.

For predictions with longer lead times, unemployment will increase as a result of financial decisions prompted by the prediction. The construction industry will be greatly affected. Even though the prediction may generate some employment in the strengthening of existing structures, businesses will postpone expansion plans, and building officials or engineers may discourage new construction as the target time nears. Marginal businesses will fail as a result of the flight of capital and decreasing sales. As business in general suffers from decreased spending, unemployment will grow, depressing the business climate still further. The downward trend will be difficult to stop.

Recommendation #1: Use federal disaster funds to implement public response plans and upgrade hazardous structures in preparation for the predicted quake. Projects of this nature could provide employment opportunities.

Recommendation #2: Promote the provision of adequate unemployment compensation or extend unemployment eligibility in the event of a long-term prediction.

Recommendation #3: Seek state or federally funded public works projects to create employment opportunities.

## ISSUE #3: City Finances: Taxes

Based on the valuation of real property, property tax revenue could decline as residents and businesses move out of a prediction zone and others hesitate to move in. It is unlikely that values would drop appreciably for a lead time of less than one year. A three-to-five year advance notice would probably cause the greatest decline.

Revenue from the taxation of inventory would decline more quickly than property tax income, with a warning period of about two years expected to produce the maximum impact. Revenue from sales tax would probably decline immediately for prediction lead times of less than one year. Income tax receipts would decline as unemployment increased: revenues from permits and licenses would be similarly affected.

Recommendation: The Mayor's Office should seek state or federal grants to compensate the City for lost revenues. The funds would probably need to be earmarked for specific uses such as prevention of earthquake damage and economic stabilization.

### ISSUE #4: Public Services

To the extent that funds for public services depend on tax revenue and the sale of permits and licenses, the services may diminish due to a loss of those revenues when a credible prediction is issued. Thses services are likely to decrease only when long warning periods are involved. Unfortunately, the demand for public services will probably increase in response to the prediction.

Recommendation: Priorities for public services may need to be reevaluated and State or Federal funding sought for important new earthquake-related services, or for the continuation of vital ongoing programs.

### ISSUE #5: National Disaster Assistance

The chain of economic decisions triggered by a prediction could culminate in effects that assume the proportions of a disaster. Heretofore, federal disaster assistance has been made available during or following a natural or physical catastrophe. The gradually increasing economic effects of an earthquake prediction will not be as obvious or dramatic as calamities that currently inspire the granting of disaster assistance. Nevertheless, the cumulative effects will warrant post-prediction, pre-earthquake support to help the community maintain a reasonable level of economic stability.

Recommendation: Following a major prediction, the Mayor's Office should 1) request that the affected community be declared a disaster area, and 2) apply for a disaster assistance program to make Federal funds available for:

a. the maintenance or augmentation of necessary City services;

b. the availability of unemployment insurance;

c. prudent hazard reduction, for example, the upgrading of hospitals, power stations, Emergency Operation Centers, and other vital service facilities; and

d. the continuation of public works programs and similar aids.

### ISSUE #6: Natural Catastrophe Insurance

With the authenticated prediction of a major earthquake, insurance companies are likely to stop issuing new earthquake insurance in the target area. Renewal of existing policies may also cease, and some may even be cancelled. Even if certain companies were willing to issue earthquake insurance, the State Insurance Commissioner would order that no new policies be issued. This directive would prevent the subsequent insolvency of companies should large numbers of costly claims be filed on the new policies.

Without any available earthquake insurance, lending institutions will provide few (if any) loans for buildings or operations within the target area. Real estate transactions and business activities could become extremely difficult at a time when greater flexibility is needed.

If reliable earthquake insurance were available, lending institutions should be willing to make investment loans, though perhaps more selectively or with higher down payments required than under non-prediction conditions. In addition, property owners could pay for their own earthquake coverage, thereby reducing the eventual demand for federal disaster assistance.

Recommendation: Various options for reliable earthquake insurance should be investigated, and a workable program developed and promoted. A national program of Natural Catastrophe Insurance (modeled after the Federal Flood Insurance Program) will probably be necessary. It would be able to provide a base of coverage broad enough to prevent a single disaster from bankrupting the entire program.

### ISSUE #7: Loan Guarantees

An earthquake prediction will stimulate a reevaluation of loans by mortgage holders, loan recipients and lending agencies. Borrowers will have reason to consider whether or not they should continue payment, and some may have difficulty keeping up with their obligations. Among other alternatives, lenders will consider the wisdom of discounting loans to stimulate payment as well as the uncertainty of making new or pending loans, even with modified stipulations.

The reactions of borrowers and lenders may be so diverse and chaotic as to require stabilizin measures.

Recommendation #1: Study the possible forms and mechanisms for loan guarantees to stabilize property values.

Recommendation #2: The Mayor's Office should seek federal and state assistance in establishing an adequate program of loan guarantees.

# Chapter 5

# Governmental Coordination and Legal Aspects

## BACKGROUND

In the event of a reliable earthquake prediction, an effective response will require that local governments in the target area develop an organized, coordinated plan, both within and between their respective jurisdictions. At present, many of the necessary structures for the formulation and implementation of a response plan do not exist. In addition, certain quasi-legal/legislative ambiguities limit the preparatory actions that local officials might take in responding constructively to an earthquake prediction.

Clarification of the powers and immunities granted to the Mayor and the City as a result of an earthquake prediction is needed.

## ISSUES AND RECOMMENDATIONS

## I. FRAMEWORK OF AUTHORITY

### ISSUE #1: Authority for Issuing Earthquake Warnings

An organized structure now exists to respond to an actual disaster, but there is no clear authority to initiate and direct the response to an impending catastrophe -- i.e., an earthquake prediction. The responsibility for issuing warnings at the local level is not clearly defined. Currently, there is no provision for such action in the City's Civil Defense and Disaster Ordinance. There is some question as to whether this authority is sufficiently protected by SB 1950 (Alquist), which adds Section 955.1 to the Government Code and allows state and local government officials, while acting responsibly and within the scope of their authority, to take reasonable and necessary actions in response to an earthquake prediction without fear of personal or local jurisdictional liability. According to the State Attorney General's Office, at present only the Governor has clear authority to issue an earthquake warning and invoke emergency procedures.

Recommendation #1: The legal authority of the Mayor to take action in the event of an earthquake prediction should be clarified.

Recommendation #2: Amend the City's Civil Defense and Disaster Ordinance to include authorization for the Mayor to issue a local earthquake warning and to activate the Civil Defense and Disaster Board and the prediction response plan when a reliable earthquake prediction is issued.

Recommendation #3: It will be necessary to clarify both the respective responsibilities of each level of government and the recommended procedures for issuing earthquake warnings and initiating various response plans.

### ISSUE #2: Earthquake Prediction Advisory Committee

The City currently has little expertise or experience in dealing with earthquake predictions or with the wide variety of issues that will arise following a prediction.

Recommendation: Establish an Earthquake Prediction Advisory Committee to assist the Mayor and the Civil Defense and Disaster Board in responding to any earthquake prediction. After studying the specific characteristics of the predictions, the advisory committee could advise the Mayor and other officials on the level and nature of response that would be appropriate.

It may happen that the prediction of a reputable scientist is rejected by CEPEC, but continues to have the full support of the person or institution which issued it. Media publicity for a prediction may have aroused the concern of the public, establishing a credibility which may be maintained despite CEPEC's position. In this case, the advisory committee could propose a low-level response plan to allay the people's fears and help them be better prepared for any earthquake.

The advisory committee could also help in assessing the confidence of the people and the probable impact of a confirmed prediction.

Structural engineers, seismologists, geologists, legal counsel, business and community leaders, and representatives from the utilities could be included on the committee. The group should report to the Mayor, and at his option, to the Civil Defense and Disaster Board.

### ISSUE #3: Monitoring the California Earthquake Prediction Evaluation Council (CEPEC)

At present, the discussions and prediction evaluations of CEPEC take place without the participation of the City of Los Angeles.

Recommendation: The Mayor should have a representative to serve as a monitor or observer of CEPEC proceedings. This representative should not be a member of CEPEC, but should have the requisite knowledge to comprehend and appreciate their discussions. He or she may come from within City government if he is qualified to understand CEPEC deliberations and has the confidence of the Mayor. The insights gained by the observer could be useful to the City's Advisory Committee and other groups in preparing a prediction response. A CEPEC observer could be designated immediately, without waiting for further study.

### ISSUE #4: Coordination With City Council

The City Council is as much a governing body as the Mayor's Office. Without their cooperation, very few programs can be implemented successfully.

Recommendation #1: Transmit copies of the Earthquake Prediction Task Force Report to each member of the City Council as background and support for any subsequent ordinances, programs or budgetary requests.

Recommendation #2: When prepared, the Earthquake Prediction Response Plan should be submitted to the Mayor and City Council for approval.

### ISSUE #5: Intergovernmental Cooperation

Since the prediction of a damaging earthquake in the Los Angeles area is likely to include jurisdictions other than the City, intergovernmental cooperation will be essential in implementing an effective response. If actions taken or recommended by the City do not receive at least philosophical concurrence from adjacent jurisdictions, public credibility could be seriously undermined and the effectiveness of advised actions substantially reduced. If a basis for intergovernmental cooperation is not established prior to the issuance of a prediction, when a crisis situation develops, much valuable time will be lost and levels of cooperation will probably be reduced.

Recommendation #1: To overcome jurisdictional fragmentation with respect to information, response capabilities and responsibilities, the Mayor should convene an intergovernmental agency meeting in order to share information which will facilitate a uniform or coordinated response by decision-makers from all affected jurisdictions. This coordination should be established well in advance of any prediction.

Recommendation #2: To prepare for the intergovernmental agency meeting, representatives of the Mayor should conduct seminars with these outside jurisdictions to inform them of the findings of the Earthquake Prediction Task Force.

### ISSUE #6: The City's Liability in Responding to a Prediction

There are questions as to the City's liability when acting or failing to take action in response to an earthquake prediction, particularly if the Governor does not issue a warning. A study in progress by the Association of Bay Area Governments (ABAG) has found no clear legal authorization for the City to invoke emergency measures before an earthquake occurs. The Office of the State Attorney General indicates that Cities are not strictly immune to liability for such actions or inactions.

Recommendation: SB 1950 (Alquist) should be clarified or amended. At present, the bill appears to grant clear immunity from liability for taking discretionary action in response to an earthquake prediction only to the Governor. The California Office of Emergency Services is considering revision of the bill to further clarify the action or non-action for which immunity is provided. The City should actively support this revision and monitor its content.

Another approach would be to secure "state of emergency" status for a prediction period, thereby gaining full immunity for local officials when they take responsible action to assure the public safety. Some attorneys believe that this was the original intent of the State legislature in passing SB 1950 (Alquist).

### ISSUE #7: Liability Related to Hazard Mitigation

It seems that the more the City does in the way of hazard mitigation, the more liability it could incur. For example, the fact that the Department of Building and Safety has conducted a survey of hazardous buildings creates the expectation that something will be done to alleviate the dangers that have been identified. This is especially true in situations of involuntary occupancy (prisons, sanitoriums, etc.). Also, a prediction with adequate lead time for remedial action could increase the potential liability of local government if appropriate actions were not initiat

In City-owned buildings, the City is responsible for damage or injury only if it can be proved negligent. Workers compensation would probably cover public and private employees injured in a predicted earthquake while on the job, but it would not necessarily absolve the City of responsibility for their safety.

Recommendation #1: As a general approach, a specific prediction response should aim for the greatest benefits with the least permanent disruption. Where resources are limited, priorities for mitigation should be established, based on the greatest saving of life and increased speed of post-earthquake recovery, with as little permanent disruption as possible.

Recommendation #2: A policy of advising rather than mandating action will create less liability and is especially appropriate for a prediction with only a moderate level of probability.

Recommendation #3: Requiring that action be taken (e.g., upgrading) rather than actually performing the action would lessen the likelihood of recrimination against the City.

### ISSUE #8: Liability Related to Damage Maps

The availability of earthquake damage prediction maps would facilitate the City's prediction response and increase inter-agency coordination by focusing complementary efforts in areas of greatest need. (See also Chapter 10, and Chapter 3, Issue #9.) However, there may be liability problems involved in the preparation and use of these maps.

Recommendation: The City should sponsor or promote the preparation of earthquake damage prediction maps, contingent on satisfactory answers to the following legal questions:

a. What liability would the City incur in publishing these maps? If a certain property decreases in value as a result of information on the map, is the City responsible?

b. Is the City's liability less if the maps are prepared, but made available only on request?

c. What liability is incurred if the maps are used governmentally in connection with a prediction?

d. What liability is incurred if the general data is in City files and the City fails to take action?

e. In order to reduce or avoid liability, what precautions should be taken in preparing and issuing the maps?

### OTHER LIABILITY ISSUES

1. If specific neighborhoods are evacuated by a City order, what responsibility does the City have to protect property in that area?

2. When an evacuation order is issued in response to a prediction as opposed to an impending disaster such as a flood, do the police have the power to demand compliance?

3. If the Governor does not issue a warning, but the Mayor decides to do so and subsequently takes appropriate actions, what are the City's liabilities?

4. What might be the City's liability if the Mayor chooses not to act either when the Governor does or does not issue a warning?

### ISSUE #9: Liability of the Press and Scientific Community

Scientists and public officials who release predictions or issue warnings that turn out to be false alarms or erroneous in some significant respect are concerned over whether they incur liability to those who suffer damage or injury because of the prediction or warning.

Tentative Conclusions:

1. In most cases, the publication of such notices should not create liability, provided the announcements are conscientiously issued, based on adequate evidence, and appropriately couched as fallible judgments rather than established facts.

2. If a prediction or warning is withheld for fear of public harm, or to the advantage of special interests, and the earthquake occurs, the possibility of incurring liability may be substantial.

### ISSUE #10: Economic Repercussions

A long-term prediction is likely to set up a chain of economic reactions that could depress property values, employment levels, tax revenues and business viability. (See Chapter 4.)

Recommendation: The City should evaluate its options, establish policy, and secure the necessary legal authority to initiate measures designed to offset extreme and detrimental economic reactions. State and Federal legislation should be sought where necessary.

### ISSUE #11: Pre-Earthquake Disaster Assistance

The Federal Disaster Relief Act of 1974 allows the President to declare a Federal emergency for specific disaster areas and make Federal disaster assistance available to the affected area. This authority has also been used to a limited extent immediately preceeding a forecasted disaster such as a major flood or hurricane, but the applicability of the act to a longer-term earthquake prediction is not certain.

Recommendation: Policy or legislative clarification should be sought to clear the way for Federal disaster assistance following the verification of a prediction of a damaging earthquake by CEPEC. Federal guidelines for the appropriate use of such funds may also be necessary.

# Chapter 6

# Safety of Buildings

## BACKGROUND

One of the greatest threats to life and safety during an earthquake is the possibility of building collapse. The earthquake resistance of buildings in Los Angeles varies from highly vulnerable to quite resilient. With a specific forewarning of a major earthquake, there would be greater impetus to correct some hazardous conditions, and to discourage the use of unsafe structures.

The greatest potential benefit from the promotion of earthquake-resistant buildings is a substantial reduction in human injury and loss of life. Modern buildings are designed to prevent all but minor (surficial) damage during a moderate earthquake, and to provide sufficient strength that the building will remain standing and allow safe exit of occupants after a major earthquake (although the building would not necessarily remain functional for normal use). The upgrading of vulnerable buildings will therefore provide a substantial savings in death and injury, with some reduction in the level of property damage, but a major earthquake could still produce high dollar losses in building damage.

To identify the areas of greatest concern for life and safety, the standards used in the construction of buildings of various types and ages were reviewed. Unreinforced masonry buildings, erected before 1934 when there were no earthquake resistance requirements, are considered to be the most likely to collapse in a strong earthquake. The potential structural and mechanical problems peculiar to buildings of other ages were also examined by the committee. A survey of interior hazards resulting from the arrangement of furniture, appliances, and fixtures completes this study of building hazards.

At about the time the Earthquake Prediction Task Force was convened, a separate study of unreinforced masonry buildings was initiated by the City Council. A preliminary draft of the study, containing code proposals for the upgrading of the buildings, is now completed. (See: Preliminary Draft Approved By the Technical Subcommittee of the Earthquake Safety Study Committee, January 30, 1978, Division 68 -- Earthquake Hazard Reduction in Existing Buildings.) A building-by-building survey of the estimated 9,000 unreinforced masonry buildings in the City is scheduled for completion by early 1979. Social, economic, and environmental assessments of the proposed correction code are scheduled or underway. If a correction code for unreinforced masonry buildings is adopted, enforcement probably will take place in several stages over a period of years or even decades.

In preparation for a credible earthquake prediction, the City needs to enact the necessary codes to establish standards for earthquake safety, as well as procedures, priorities, and timetables to serve as guidelines in the enforcement of these standards. An ongoing program should be initiated as soon as possible to identify and upgrade unsafe structures. Once the basic standards and priorities are established, augmentation or acceleration of the program can be implemented as appropriate in response to a specific earthquake prediction. The City should also seek, in advance, emergency funding sources to be called upon at the time of a substantial prediction. In addition, both owners and occupants should be encouraged to correct interior hazards caused by equipment, fixtures, and furnishings. The fact that we live in an earthquake prone area should provide the motivation to activate both public and private sectors of the community.

When a prediction is issued, the City should immediately solicit emergency funds to be used in an accelerated program of structural upgrading, based on pre-established priorities. All feasible means should be employed to hasten this program in order to protect occupants in the most practicable way. Existing deadlines should be reevaluated, along with some reevaluation of priorities, and at the appropriate time, hazardous buildings could be evacuated. A long-term prediction would provide an opportunity to reinforce some hazardous structures and to locate housing for residents of buildings that may fail during the earthquake. A short-term warning could allow people to relocate temporarily or to postpone business in hazardous structures. Knowing which buildings are basically safe would help reassure residents, and, in comparison, would focus attention on buildings with substantial hazards.

## ISSUES AND RECOMMENDATIONS

### 1. POTENTIAL BUILDING HAZARDS RELATED TO DATE OF CONSTRUCTION

This section is divided into dates of construction related to major changes in the Los Angeles Building Code. There are likely to be individual buildings that provide both positive and negative exceptions within each category.

### ISSUE #1: Pre-1934 Buildings

Unreinforced masonry buildings (built before 1934) pose the greatest life hazard in an earthquake.

Recommendation #1: Considering such factors as ease of rehabilitation, type of occupancy, and socio-economic needs of the community, priorities for reinforcement, decreasing occupancy levels, or demolition should be established before we are confronted with a credible earthquake prediction. It is generally agreed that our priorities are: first--people, second--vital service buildings, and third--other buildings. The Earthquake Safety Study Committee, in the preliminary draft of their report (January 30, 1978), proposed the following Priority Rating Classification:

I. Essential Facilities (See Vital Structures, p. 24 of this report).

II. High Risk Occupancies -- 100 occupants, used more than 20 hours a week.

III. Medium Risk Occupancies -- 20 occupants or more.

IV. Low Risk Occupancies -- less than 20 occupants.

When a scientifically valid long-term prediction is issued, the enforcement of a Seismic Safety Code could be acclerated according to these priorities.

Recommendation #2: Develop a contingency plan for accelerating implementation of the pending unreinforced masonry code in the event of a credible earthquake prediction. The plan should include options for upgrading, vacating, or demolishing buildings that have not yet complied with the code.

The report of the Earthquake Safety Study Committee, mentioned above, includes (1) detailed suggestions on procedures for issuing orders to demolish or repair unreinforced masonry buildings, (2) analysis and design requirements, and (3) recommended construction materials.

Recommendation #3: Maps should be prepared to show where hazardous housing structures are located. Develop an evacuation plan to allow for the orderly movement of the occupants of these buildings to safe areas in the event of a valid prediction. Information indicating which structures and areas are expected to be safe in an earthquake should be widely distributed following a major prediction.

Recommendation #4: Take advantage of lead time to plan for long-term relocation of those individuals whose housing may be destroyed by an earthquake or condemned as a result of one. (Tens of thousands of people may require housing following a very large local earthquake.)

### ISSUE #2: 1934-1959 Structures

After the 1933 Long Beach earthquake, new buildings were required to be resistant to lateral earthquake forces. Limited to 13 stories in height, these structures were designed in accordance with known earthquake concepts and building codes of that time. There may be some internal hazards related to the safe-exiting provisions and the mechanical components of these structures (elevators, electrical systems, fire suppression systems, etc.). However, the materials and design utilized during this period make these buildings relatively earthquake safe. A valid earthquake prediction could provide the stimulus for building owners and lessees to evaluate and correct the earthquake performance of their older mechanical systems.

Recommendation #1: Develop criteria and guidelines for upgrading the mechanical systems of structures built between 1934 and 1959. Include a methodology for the evaluation of the potential hazards of the following: (1) mechanical equipment performance, (2) utility connections and shut-offs, (3) safe exit, (4) fire safety, and (5) collapse resistance factor. In addition, suggestions should be formulated for any improvements, rehabilitation, and strengthening that will produce greater safety. These guidelines should be established now, so that implementation may begin.

Recommendation #2: Encourage voluntary upgrading prior to a verified prediction.

Recommendation #3: Evaluate alternate means of enforcing Building and Safety Department orders to repair or demolish buildings that do not meet seismic force requirements. After a prediction, certain types of upgrading could become mandatory and specific deadlines for compliance defined.

### ISSUE #3: 1959-1973 Structures

In 1959, the 13-story height limit was lifted as earthquake design standards were modified. With the advent of high-rise buildings, additional problems evolved. During an earthquake, furniture moved as a result of the great "sway" of the buildings, and the logistics of fire-fighting and emergency exits became more complicated. The earthquake force factor assumed to be adequate and utilized for design between 1959 and 1973 was lower than the factor accepted and used today.

Recommendation #1: These buildings should be evaluated in terms of important differences between the 1959 codes and current building codes. The evaluation should include:

a. The capability of providing safe exit, with reference to elevators, stairways, exit doors, and crowd control.

b. Fire suppression capabilities -- with special attention to structures over 12 to 14 stories in height, water sources, presence of flammable materials, utilities, equipment, and other fire related factors.

c. Utility safety, with specific reference to gas pipelines and gas fixtures.

d. The use of automatic shut-off valves for gas and electrical systems, with reference to the possible need for redesign of shut-off valves to be triggered only by large, damaging earthquakes.

e. The need for anchoring of furniture, fixtures, equipment, and utilities.

f. Occupant safety relative to building motion.

g. Distribution of information to occupants on special, orderly exiting procedures following an earthquake.

Recommendation #2: Voluntary improvements of the deficiencies revealed by the above evaluation should be encouraged.

Recommendation #3: At the time of a prediction, the repair of the most hazardous deficiencies should be ordered and a time limit placed on compliance.

### ISSUE #4: Post-1973 Structures

Based on problems ecountered in the 1971 San Fernando earthquake, new earthquake design requirements were introduced in 1973 and 1974 as a result of the recognition of a greater severity of ground motion in the vicinity of the epicenter. Fire codes for high-rise structures were also strengthened.

Recommendation: The performance of these buildings during earthquakes should continue to be evaluated. Deficiencies discovered could be repaired on a voluntary basis before a prediction is in effect. The correction of major deficiencies could be required during a prediction period.

## II. SPECIAL PROBLEM AREAS

### ISSUE #5: Wall Anchorage

The purpose of wall anchorage is to securely connect heavy masonry or concrete walls to the roof and floor framing of a building, thus preventing the wall from pulling away from the framework. The anchor itself consists of a steel strap or bar that is embedded into the wall, then nailed or bolted to a roof or floor framing member. The embedded end of the anchor is equipped with a hook or bolt to increase pullout resistance. Anchors are usually spaced about four feet apart around the floor and roof perimeter. Any existing anchors in unreinforced masonry buildings may be inadequate due to weak mortar and lack of pullout resistance. (In 1973, the City Building Code was amended to require wall anchors in all new construction; Code Section 31.2306b.)

Recommendation #1: All buildings constructed prior to 1973 should be retrofitted with wall anchors. An ordinance to this effect should be developed. In unreinforced masonry buildings, additional anchors that pierce through the entire wall may be required.

Recommendation #2: Information on the importance and installation procedures of wall anchors should be circulated. Voluntary retrofitting should be encouraged before a prediction, and corrections could be required after a warning is issued, if there is adequate lead time.

### ISSUE #6: Deterioration of Wood Trusses

Long-span trusses, which were common in construction of the 1940's and 1950's can develop splits and cracks in the chord members and at connections.

Recommendation: All wood trusses should be closely inspected. Where defects are noted, repairs should be made or the members replaced. All bolted connections should be checked for tightness. These corrections could become mandatory after a prediction is announced.

ISSUE #7: Rod Bracing Systems

Many buildings have rod bracing systems which are intended to resist earthquake forces. These usually consist of cross braces with adjustable turn buckles on each rod.

Recommendation: In response to a prediction, rod systems should be checked to make sure they maintain the design tension.

ISSUE #8: Building Hazards

Deficiencies in existing buildings may include:

a. inadequate or worn-out support systems,
b. lack of proper exiting facilities,
c. physical deterioration,
d. inadequate protection against fire.

Recommendation: All deficiencies which jeopardize the security of life and property should be identified, then corrected on a voluntary basis prior to an earthquake warning. During a prediction period, correction of life-safety hazards could be required.

ISSUE #9: Suspended Ceiling Systems

Some buildings with suspended ceiling systems constructed prior to 1974 do not have lateral support wires to prevent the ceiling from buckling and collapsing during an earthquake. In 1974, the Department of Building and Safety adopted RGA 4-74, which requires lateral support for all suspended ceilings larger in area than 144 square feet.

Recommendation: These provisions should be extended to apply to suspended ceilings installed prior to 1974. Compliance should be required when an earthquake warning is in effect, if not sooner.

ISSUE #10: Rooftop Mechanical Equipment

Many buildings, particularly older structures, have accumulated considerable mechanical equipment on their roofs.

Recommendation: Owners of buildings with extensive roof-mounted equipment should consult a licensed engineer to determine whether their roof system is adequate for the superimposed loading and whether the equipment is properly anchored. When a prediction is verified, necessary adjustments should be ordered, if they have not already been completed.

ISSUE #11: Metal Lath

Many buildings constructed prior to 1934 have plaster ceilings with metal lath supported by wood joists. Past experience has shown that where the attachment of the metal lath to the wood joist is only by vertical nailing through the metal, a very dangerous condition exists.

Recommendation: These ceilings should be reanchored to positively support the ceiling load. In buildings where this has not been done by the time a prediction is confirmed, reanchoring should be compulsory.

ISSUE #12: Gas Shut-Off Valves

Gas lines may rupture during an earthquake, leaking highly flammable, noxious gas into the environment.

Recommendation: Encourage the development and marketing of well-designed automatic gas shut-off valves. These new valves should be designed to go into action only after strong earthquake shaking of a duration which would normally cause earthquake damage. Triggering by a passing truck or accidental bump should not be possible. Under conditions of an earthquake prediction, installation of shut-off valves could be strongly encouraged.

ISSUE #13: Elevators

New standards for the seismic safety of elevators have been proposed by the Los Angeles Department of Building and Safety. Based on empirical evidence carefully derived from first-hand surveys of the damage caused by the 1971 San Fernando earthquake, the new code requires retrofits according to the California Administrative Code, Title 8. Its coverage of other safety features, however, is different from the state regulations. Protective devices such as an early detection seismic switch, collision and derailment warning switches, signal devices, and special equipment guards would be required. The object of each requirement is to insure the safety of the occupants of an elevator during and after a severe earthquake. These various mechanical components are designed to stop the operation of the car, holding the people inside until they can be unloaded without harm.

Recommendation #1: The City Council and Mayor should approve the new elevator code at the earliest opportunity so that compliance with its standards may begin and postponement of its proposed compliance deadline of October 6, 1980, can be avoided. The Earthquake Prediction Response Plan could include provision for accelerating enforcement deadlines if a major local earthquake is predicted.

Recommendation #2: The public should be forewarned that following an earthquake, elevators will not be operating and should not be used until they are checked for safety.

## III. POTENTIAL HAZARDS TO VITAL STRUCTURES

Buildings that provide vital services have special value to the community in the wake of a disaster. Hospitals and emergency response facilities are especially important to post-disaster operations, and structures with involuntary occupancies (nursing homes, schools and jails) may require special attention to the safety of their occupants. To maintain the post-disaster effectiveness of vital structures, it is necessary not only to assure their continued functioning, but also to offer a reasonable degree of safety to the people who use them. A prediction will allow time to help accomplish this.

### ISSUE #14: Hospitals

In the target area, it is essential that hospitals remain functional after the earthquake.

Recommendation #1: Hospitals should be surveyed to determine (1) which will probably remain functional, (2) what type of services each will be capable of dispensing, and (3) their accessibility during and after an earthquake. Contingency plans should then be designed with the functionality factor in mind. When a prediction is issued, the contingency plans can be adjusted to the specific time, place, and intensity of the anticipated quake and implemented promptly.

Recommendation #2: The Mayor should consider City-sponsored or supported legislation which requires existing hospitals to comply with current earthquake safety building standards. This legislation should include an appropriation for financial assistance to all public and private hospitals to facilitate this upgrading, as both public and private hospitals perform crucial services in the emergency aftermath of an earthquake. Upgrading should be implemented as expeditiously as is practicable.

Recommendation #3: Following a prediction, vital supplies stored in vulnerable structures should be relocated.

Recommendation #4: In response to a prediction, hospitals outside the target area should be prepared to provide temporary additional service.

Recommendation #5: Emergency power sources should be checked in hospitals expected to remain operative. Larger stand-by fuel supplies may need to be arranged.

Recommendation #6: When an earthquake is imminent, long-term and life-support patients could be relocated out of the prediction area; patients should be released whenever possible, and elective surgery should be postponed.

### ISSUE #15: Emergency Headquarters

The Mayor's Command Post, Police and Fire Command-Dispatch Centers, Telephone Communication Centers, and Public Utility Emergency and Command Centers are vital to earthquake response.

Recommendation: The earthquake resistant capabilities of these structures should be evaluated. Those that are not likely to withstand a damaging earthquake should be rehabilitated or replaced. When a prediction is received, plans should be accelerated or vital services relocated.

### ISSUE #16: Non-Voluntary Occupancy

Structures such as private schools, nursing homes, sanitariums, and detention facilities should be checked for seismic safety. (The City has no authority over public schools, which are regulated by the State.)

Recommendation #1: Inspect and evaluate these buildings with regard to structural integrity, exiting facilities, and fire protective construction.

Recommendation #2: Encourage the rehabilitation of those found deficient, and require that major hazards be corrected or eliminated. Expedite compliance when a prediction is verified.

Recommendation #3: Where life hazards remain, facilities should be vacated as the target date nears.

Recommendation #4: Detention facilities should be extremely earthquake resistant, even to potentially hazardous but non-structural damage. Ideally, they should not require evacuation or excessive surveillance during the emergency. Work towards this goal, and expedite progress after a prediction. Long-term prisoners in substandard facilities could be relocated outside the prediction area as an earthquake becomes imminent.

### ISSUE #17: City-Owned Buildings

The City owns almost 200 unreinforced masonry buildings which are vulnerable to collapse in an earthquake. Of these, a number house fire and police stations and other facilities of critical importance to an earthquake recovery effort. Other hazardous structures are used as offices, libraries, and other high occupancy uses. The current program to replace these buildings is proceeding slowly because funds must be found in the capital improvement budget.

Recommendation #1: When a major long-term prediction is verified, the replacement effort must be accelerated.

Recommendation #2: As the predicted time draws near, offices and vital facilities should be temporarily relocated, perhaps to temporary buildings brought in for this purpose.

Recommendation #3: Federal funding should be requested for substantial preventive actions taken in response to a prediction.

## IV. GENERAL RECOMMENDATIONS

### ISSUE #18: Coordination

Coordination with various state and county agencies, city departments and volunteer organizations will facilitate the judicious, efficient use of available resources.

Recommendation #1: Formulate and implement plans for cooperation among these groups for evaluation, remedial work, and relocation of essential facilities, beginning in the pre-prediction planning stage.

Recommendation #2: Investigate which professional organizations can provide expert advise to help City departments. Call on them for assistance in planning and implementation, before and after the prediction.

### ISSUE #19: Public Inquiry

Immediately after a prediction is made, the public, City officials, and the news media will demand to know what is being done to insure the safety of the buildings they occupy.

Recommendation #1: Affected City departments should cooperate in the development of a contingency plan now to help assure the safety of building occupants in an earthquake. The plan should include procedures for evaluating the structural stability of buildings and identifying areas of potential architectural and decor hazards within buildings, and mitigating measures could be taken. The plan should address the safety of private as well as public buildings, and be suitable for implementation either before or after a prediction is made.

Recommendation #2: When an earthquake is predicted, the Mayor should direct City departments to implement the contingency plan for all public buildings. He should urge owners to expedite upgrading to comply with the latest Building and Safety regulations. Occupants should be actively encouraged to follow recommended safety precautions in preparing interiors for the impending earthquake.

Recommendation #3: Appropriate City departments should prepare lists of hazardous items which could be corrected within the time frame of the prediction, and complete such correction.

Recommendation #4: Rather than wait for "disaster relief" after the event, the Mayor should support legislation which will make funds available for hazard reduction prior to the earthquake, especially in response to a verified prediction.

## ISSUE #20: Securing Citizen Cooperation

Everyone can participate in preparing the buildings in which they live and work to better withstand a damaging earthquake. Constructive action by the people can result in substantial hazard reduction in building interiors. In the 1971 San Fernando earthquake, non-structural damage was far more costly than structural damage.

Recommendation #1 - Education: Before and after a prediction announcement, inform the people as thoroughly as possible about the kinds of hazards that may exist in the buildings they occupy, and of protective measures that they may take to increase their safety. Recommend that they plan ahead and implement protective measures as soon as possible, and to institute any additional interim measures as the lead time narrows.

Recommendation #2 - Fire Prevention: Families, offices, etc., should be instructed to:

a. develop a fire response plan;

b. learn how to fight home fires and use home fire equipment; and

c. acquire and store equipment and supplies for quick and easy access.

As the predicted date approaches, they should:

d. assemble and ready supplies for fire prevention and control, for example, a garden hose, ladder, fire extinguisher, buckets of sand, a multi-purpose or crescent wrench (to turn off gas valves), etc.;

e. search homes for fire hazards and eliminate them;

f. provide easy access to safe exits; and

g. provide for safe storage of vital records.

Recommendation #3 - Prevention of personal injury and property damage: In response to a prediction, encourage individuals to:

a. check ceiling support; reinforce if necessary; attach fixtures securely;

b. check for hazardous furniture arrangements (bed should not be under window or bookcase, etc.);

c. secure furniture, appliances, and other heavy objects for greater stability: bolt in tall cabinets and bookcases; bolt down gas appliances;

d. rearrange shelves, placing heaviest objects on bottom; secure bookcases and kitchen cabinets to prevent damaging spills;

e. assemble home care tools: crowbar, asbestos gloves, hammer and nails, pliers, screwdrivers;

f. provide for the special needs of the elderly and the handicapped.

(These suggestions come from "How To Survive An Earthquake," a publication of Creative Home Economics Consultants, Chec Publications, 1977.)

## ISSUE #21: Post-Earthquake Evaluation

Immediately following an earthquake, a large number of technically qualified persons will be needed to evaluate structural integrity and incipient hazards. Professional organizations such as the Structural Engineers Association of Southern California have worked with the State Office of Emergency Services in disaster preparedness and disaster response programs.

Recommendation: During the prediction period, arrange for organizations like this to be part of the City's post-earthquake plans.

# Chapter 7

# Hazardous Facilities and Lifelines

## BACKGROUND

Earthquake prediction offers a unique opportunity and time frame for implementing specific measures to (1) safeguard potentially hazardous facilities, and (2) help ensure the continued operation and prompt recovery of essential lifeline facilities. The primary objective of such programs would be life safety. Secondary goals are to minimize social and economic disruption, prevent major health hazards, reduce property loss, and facilitate post-earthquake recovery.

The lifelines of the City are its transportation, communications, water, energy, and waste disposal systems. A major earthquake of Richter magnitude 8.5 on the San Andreas Fault or a magnitude 6 to 7.5 earthquake on one of the local faults would generate strong ground shaking in the City of Los Angeles and could inflict heavy damage to lifelines, particularly those which cross the activated fault zone or are buried and supported on unstable ground. Older facilities such as partially-deteriorated pipelines or unreinforced masonry buildings could be vulnerable even in areas of moderate ground movement. An Earthquake Prediction Response Plan must deal with the protection of these lifelines as well as the fastest possible restoration of service for facilities disrupted by an earthquake.

A wide variety of existing facilities within the City could pose hazards to surrounding areas and demand immediate attention from hard-pressed emergency personnel if those facilities were damaged during an earthquake. Pipelines, refineries, and storage tanks containing gas and petroleum products could be vulnerable to fire or explosion. Some older dams may be vulnerable to damage and potential collapse. Caustic, flammable, and chemically reactive substances are transported, stored, and marketed in many areas of the City for industrial and commercial uses. Radioactive substances used for medical, industrial, and experimental purposes as well as research atomic reactors might produce contamination if their containment facilities were severely damaged.

An Earthquake Prediction Response Plan could ensure that adequate standards are set to prevent critical damage from an earthquake. The plan should establish procedures for rechecking or requiring compliance once a prediction is validated, and should help focus disaster response plans for greater effectiveness in areas most vulnerable to the predicted earthquake.

In order to reduce earthquake hazards substantially, a coordinated, continuing program of hazards reduction must be in effect before a prediction is made. This program should include a response plan of step-by-step procedures to be followed after a prediction is announced. All response plans will need to consider the range of lead times that could be available between a prediction announcement and the anticipated date of occurrence of the earthquake.

In the aftermath of the 1971 San Fernando earthquake, a number of agencies sponsored investigations which analyzed the earthquake damage and made recommendations to increase seismic safety. Public as well as private institutions involved with lifeline facilities, dams, or hazardous materials now have ongoing programs to study and improve seismic safety. With the exception of dams and State highways, most of the current implementation deals with new construction and installations. The more difficult problems of upgrading older facilities have not been adequately resolved.

Industry, businesses, and citizens can play an important role in hazard reduction. They will need to know how to prepare themselves and their communities as well as how to respond in the event of damage to lifelines or hazardous facilities in their vicinity.

## ISSUES AND RECOMMENDATIONS

### ISSUE #1: Coordination

Many independent organizations and industries are currently reviewing seismic safety standards for their areas of concern, as are numerous public agencies and departments. Some activities have reached the implementation stage, whereas others have only identified some of the existing hazards.

Recommendation #1: The City could assume responsibility for encouraging, assisting, supporting, and coordinating the efforts of public and private lifeline agencies as well as industry to develop specific plans for hazard reduction.

Recommendation #2: The Civil Defense and Disaster Board should be expanded and assigned responsibility for the coordination and monitoring of the various hazard reduction programs.

Recommendation #3: The analysis of specific hazards and planning for their mitigation should be the direct responsibility of the individual agencies and industries concerned, for they have the knowledge and expertise required for this specialized task.

Recommendation #4: The City's Seismic Plan could be used as a guide in organizing all hazard reduction programs. The plan outlines in general terms certain policies and programs to reduce earthquake hazards and to improve performance of lifelines in an earthquake. It should be augmented to include a delineation of potential soil liquefaction areas and unstable ground. A U.S.G.S. or N.S.F. grant might be sought to provide the funding and expertise to do a reliable survey of this complex and rapidly evolving topic.

## ISSUE #2: Response Level Geared to Lead Time

A long lead time before the predicted earthquake will allow programs of major upgrading, extensive citizen education, reduction of inventories, and shifting of personnel, supply sources or storage areas. A short lead time would be more compatible with such measures as limited evacuation, temporary shut-down of hazardous facilities, or increased on-call staffing to handle problems as they arise.

Recommendation: Plan various levels of response for each lifeline system or hazardous facility, geared to short, intermediate, or long lead times.

## ISSUE #3: Identification and Mitigation of Hazards in the Lifeline Systems

Maintenance of service in all of the lifeline systems is one of the City's highest priorities. The more that can be done in advance to safeguard these facilities, the faster the City will be able to recover from an earthquake.

Recommendation #1: Before a prediction is received, each City department and each private utility should identify specific earthquake hazards to the lifeline systems under its jurisdiction and initiate a program to remedy those hazards. Maps showing where major lifelines within the City cross active faults should be kept current. (California Division of Mines and Geology, Los Angeles County Engineer, the Departments of City Planning, Public Works and Building and Safety all have fault maps for this area.)

Recommendation #2: When a warning is issued, upgrading of hazardous conditions should be expedited.

Recommendation #3: The Mayor's Office should be kept informed of any government or citizen assistance (e.g., evacuation) needed by City departments or private companies.

Recommendation #4: The California Public Utilities Commission and the California Seismic Commission should be consulted and even involved in efforts to assess lifeline preparedness.

## ISSUE #4: Safeguarding Hazardous Materials

A wide variety of businesses and industries in the City use, transport, store, or sell materials (primarily fluids and gases) that are caustic, flammable, or highly reactive. In some instances, two or more chemicals stored in close proximity produce hazardous substances only when mixed. Moderate to severe ground shaking during an earthquake can rupture storage tanks and pipelines, create traffic problems that endanger haul trucks, disrupt and endanger rail transport, and cause breakage of bottles and other containers (toppling from shelves could be widespread). Most operations using hazardous materials are technically required to register with the City or County, but enforcement and follow-up is lax in many cases.

Recommendation #1: Preceeding an earthquake prediction, the Fire Department and Building and Safety Department should expand their periodic review and updating of City regulations for the storage and transport of hazardous materials to include an evaluation of the resistance of existing storage facilities and pipelines to earthquake shaking.

Recommendation #2: The Fire Department should maintain an up-to-date record of all buildings and their owners where hazardous materials are stored. Information on the type of hazardous materials to be found at each location should be available in each fire-fighting vehicle or station house.

Recommendation #3: The Fire Department should work with organizations that handle hazardous chemicals to identify specific potential hazards under their jurisdiction and recommend mitigation measures.

Recommendation #4: Fire Department and Building and Safety Department personnel should conduct inspections in selected cases to consider structural as well as material safety at the same time. Major facilities such as gas and petroleum storage areas would warrant such systematic inspections, as would older structures which have hazardous materials inside.

Recommendation #5: The City should establish procedures for business and industry to report potentially hazardous situations that require government or citizen participation for effective mitigation.

Recommendation #6: The Civil Defense and Disaster Board should prepare guidelines or a stand-by ordinance to require all holders of City or County permits for the storage or transport of hazardous chemicals and radioactive materials to prepare plans showing the means they will use to protect their inventory and prevent the escape of hazardous materials during or after an earthquake. Implementation and follow-up would be especially appropriate during the span of a moderate- to long-term prediction.

### ISSUE #5: Modification of Existing Facilities

Some earthquake hazards can be reduced only by modifying existing facilities or pipelines. Because a large majority of earthquake hazards are related to older, substandard or deteriorating installations, upgrading efforts are very important. However, the logistical difficulty of the work and the large number of older facilities would require extensive time and financial investment.

Recommendation #1: Encourage upgrading by authorizing funding or a rate increase. Where private utilities are involved, request State assistance to obtain appropriate rate increases from the Public Utilities Commission.

Recommendation #2: Prior to a prediction, establish priorities and procedures for safeguarding critical facilities that may need upgrading work.

Recommendation #3: After a validated prediction is received, special interim measures should be taken (1) to safeguard hazardous facilities that have not received needed modifications, (2) to shift lifeline operations to more reliable facilities wherever possible, and (3) to provide adequate plans, personnel, and supplies for the prompt restoration of lifelines that could be damaged by the earthquake.

### ISSUE #6: The Harbor Area

The Los Angeles harbor area is especially vulnerable to earthquakes due to its proximity to the Palos Verdes and Newport-Inglewood Faults, and to geologic conditions which make much of the area susceptible to ground failure, soil liquefaction, and possibly surge waves from seiche action. In addition, the high concentration of petroleum refineries, hazardous chemical plants, storage facilities, pipelines, and fuel unloading facilities intensifies the risk of explosions, major fires that could spread quickly on top of the water, and leakage of toxic materials onto harbor waters, endangering a great number of people. Bridges that provide access to Terminal Island could be damaged, possibly beyond use. Continuing operation of the harbor following an earthquake would be important for the supply of materials, personnel, special equipment, and fuels, and as an avenue for limited evacuation. Major damage to the harbor would greatly inhibit the economic and physical recovery of the area.

Recommendation #1: A study should be undertaken by the City and its Harbor Department to investigate and evaluate the following factors:

a. Stability of the various bridges in the harbor area. (The City should request Caltrans to analyze the Vincent Thomas Bridge.)

b. Probability of disrupted road access.

c. Susceptibility to soil liquefaction and other earthquake-related ground failure and the resulting effects on:

(1) vehicular and boat transportation;

(2) docks, important warehouses, and essential equipment (cranes, etc.);

(3) petroleum and chemical storage tanks;

(4) pipelines carrying explosive and toxic liquids and gases;

(5) refineries and chemical processing plants.

d. Adequacy of the basins around the two large tanks of liquid petroleum gas to catch the overflow of one or both of the tanks if ruptured.

e. Fire hazard:

(1) possible causes of fire;

(2) spreading agents and containment methods;

(3) extent of possible conflagration.

f. Probability of water pipeline failure and resulting effects on fire-fighting: possible use of water from the harbor for fire-fighting.

g. Alternate means of transporting casualties and emergency equipment:

(1) by water;

(2) by air.

Recommendation #2: When the analysis outlined above is completed, develop long-range plans to respond to each potential problem.

Recommendation #3: Develop parallel contingency plans to deal with the major problems on an interim basis when an earthquake prediction is verified.

Recommendation #4: As the prediction "window" approaches, emergency supplies could be stored for personnel who cannot get home after the earthquake. Food, water, sanitation facilities, bedding, etc., may be needed.

Recommendation #5: Enlist the support of agencies and industry located in the area. Coordination of efforts among Harbor personnel, Emergency Services, oil companies, and hazardous material industries is essential.

a. The Harbor Department should determine the capabilities of cooperating agencies such as the Coast Guard, Navy, Army, Marines, State Office of Emergency Services, etc., to provide supportive aid in the event of a damaging earthquake.

b. The capabilities of industry to provide manpower and equipment for firefighting and other emergency services should be determined prior to a damaging earthquake. Contingency plans should be established that will include these capabilities, and agreements to cooperate should be confirmed.

Recommendation #6: Assuming that telephone service will not be functional, base unit radio systems should be provided to communicate with the Los Angeles Police, Fire, and Health Departments and with the Coast Guard and Navy.

Recommendation #7: Assuming that transportation routes will be blocked, prearranged command posts for the Los Angeles Police, Fire, and Health Departments should be established.

Recommendation #8: Pre-determine priorities for the repair and restoration of harbor facilities. This will save time, resources, and energy in reestablishing the Port as a viable entity.

## ISSUE #7: Water Supply

The City's water supply consists of three basic components: the aqueducts and wells delivering the basic supply; tanks, dams, and reservoirs that provide storage; and the distribution system of pipelines under the City streets. The aqueducts and distribution system cross active faults in various areas. The distribution system also crosses potential landslide and soil liquefaction areas. Damage or rupture of pipelines is likely to occur whenever extensive ground movement occurs. Some of the older dams could be vulnerable to damage from an earthquake, and, even if collapse does not result, damaged reservoirs would probably be drained rapidly to prevent further problems, thus reducing the water available for emergency needs. Although wells in the San Fernando Valley and Los Angeles Basin could serve surrounding areas when reservoirs or distribution lines from outside the area are damaged, they are not routinely equipped with emergency power generators, and are likely to be out of service following an earthquake.

Recommendation #1: Review and upgrade the City's distribution system, particularly where active faults are crossed as well as in other areas susceptible to ground movement. Continue to replace and upgrade substandard and deteriorating distribution lines.

Recommendation #2: Continue to improve the versatility of the water system in terms of alternate connections and distribution lines that could be used when local damage to major distribution lines occurs.

Recommendation #3: Provide emergency power generators for a reasonable number (perhaps half of the total) of wells and pumping stations, especially for those in vital locations.

Recommendation #4: Following a long-term earthquake prediction, review and expedite the upgrading of the water system. Consider borrowing tank trucks for emergency water distribution. Educate citizens to store drinking water and to sterilize water by boiling or by solar distillation if the safety of the water is in doubt. In addition, the accessibility of alternate and stand-by water supplies could be enhanced. Emergency generators for wells and pumps should be checked, and some could be relocated closer to the potential damage areas identified by the prediction. As the time of the earthquake approaches, more operating personnel could be put on stand-by.

### ISSUE #8: Dams

Older earth fill and concrete arch dams could sustain substantial damage in a major earthquake. If cracks were to occur in the earth fill dams, erosion due to leakage would tend to widen any cracks, producing further damage and possible dam collapse. The City's Department of Water and Power owns and operates many dams in the Los Angeles area as well as in Inyo and Mono Counties.

Recommendation #1: Continue to cooperate with the State Division of Safety of Dams in evaluating and upgrading existing dams, and replacing vulnerable dams where necessary.

Recommendation #2: In conformance with State law, develop an evacuation plan for potential inundation areas below dam sites. (Only 8 of 24 remain to be completed.) The State Office of Emergency Services has Flood Inundation Maps available for every dam and its downstream community. Citizens living in these areas must be informed of special precautions being taken and of procedures and suggested routes for orderly evacuation if the need arises.

Recommendation #3: Following an earthquake prediction, reservoir levels could be judiciously and selectively lowered if necessary for safety reasons.

### ISSUE #9: Energy Supply

During an earthquake, electrical generation units may be damaged, blacking out parts of the City. The restoration of power service after any outage is a high-priority matter.

Recommendation #1: Existing programs to anchor and support power equipment in place should be continued and encouraged. Continuing improvement of the seismic resistance of pre-1934 masonry buildings which house power distribution equipment should be supported, and ongoing studies to improve earthquake design standards for new equipment and facilities should be encouraged.

Recommendation #2: In future City franchises, seismic safety standards and operating procedures recommended by industry or professional groups for new or existing gas and petroleum lines should be incorporated.

Recommendation #3: Agencies and industries responsible for pipelines should continue to develop emergency preparedness plans including the mapping of shut-off valve locations.

Recommendation #4: All of these measures should be expedited when a prediction is announced.

### ISSUE #10: Roads and Highways

A major earthquake is likely to result in the collapse of some bridges and overpasses, local buckling of roadway segments, widespread failure of traffic control lights, and numerous accidents due to loss of vehicle control during strong ground shaking. In addition to the life hazards involved, emergency access to hard-hit areas could be jeopordized by road outages and compounded by severe traffic congestion. Good road access will be a major factor in the rate of post-earthquake recovery.

Recommendation #1: The seismic resistance of all bridges on major routes within the City should be evaluated, and a program of structural upgrading implemented.

Recommendation #2: Preceeding an earthquake prediction, mutual aid agreements should be reached between the City and County regarding the opening and closing of roads for rescue purposes and for emergency vehicles such as fire fighting equipment.

Recommendation #3: If a major prediction is received, bridge reinforcement could be accelerated, with greater emphasis on areas expected to receive higher levels of damage from the predicted earthquake. Damage prediction maps would be extremely useful for this purpose.

Recommendation #4: As the predicted time of the earthquake nears, people should be encouraged to keep road travel to a minimum in order to reduce exposure to highway hazards and to keep roads clear for emergency access. The rescheduling of work hours could be promoted to avoid rush hour congestion.

Recommendation #5: The public should be instructed on special driving procedures to be used in an earthquake, including:

a. Slow down gradually by "pumping" brakes to avoid skids and to alert following drivers. If there is severe ground shaking, anticipate that most drivers will have some difficulty controlling their cars.

b. Avoid stopping at a bridge or overpass, but pull over and come to a stop at the first reasonable opportunity.

c. Once the earthquake has subsided, check the safety of passengers and others in your vicinity, then proceed slowly, being especially alert for road damage and other hazards.

Recommendation #6: Especially hazardous road segments (vulnerable bridges, marsh crossings, etc.) may need to be closed and traffic rerouted for the duration of a prediction "time window."

### ISSUE #11: Los Angeles International Airport

During an earthquake, ground lurching might wreak havoc with airport runways, causing some or all of them to be inoperable. Fortunately, the airport has a comprehensive Emergency Response Plan ready for implementation at a moment's notice. The emergencies which occur at the airport as part of routine operations require preparations similar to those necessary for an earthquake. Airport personnel are trained to cope with crowd control, damaged runways, impaired communications, power shortages, etc. If the natural gas supply were interrupted by a major shock, emergency power could be supplied for several days by stand-by generators which are operated on diesel fuel. Thus, communication and lighting facilities could remain functional.

At this writing, the airport has no plans to respond to an earthquake prediction per se. To determine what advance preparations could be taken in response to an earthquake warning, special study would be necessary.

Recommendation: Some of the measures that should be considered as possible responses to a prediction are:

a. Determine the vulnerability of runways to general lurching.

b. Inform the public of precautions and procedures for an earthquake.

c. Review and rehearse emergency procedures with all employees.

d. Advise travelers to curtail air travel as appropriate.

e. Reduce the use of elevators.

### ISSUE #12: Bus and Rail Transportation

If roads and rail lines are operative and fuel is available, public transit facilities which remain functional can aid in the supply of food, equipment, and manpower to the disaster area, and an evacuation or relocation of people from the most severely damaged areas.

Recommendation #1: Establish a public transportation committee composed of representatives from the City agencies responsible for public transportation and traffic, as well as people from the transportation companies themselves.

Recommendation #2: The committee should:

a. Plan for the direction and coordination of public transit facilities following an earthquake.

b. Establish liaison with Emergency Operation Centers.

c. Inventory vehicles and equipment likely to be available in a disaster.

d. Plan to utilise trucks, taxi cabs, airlines, private airplanes and ships as necessary.

e. Study the relationship of fault systems and other earthquake hazards to transportation system facilities.

f. Identify measures that can be taken to minimize damage to transit facilities in response to a specific prediction, such as:

(1) strengthening of fixed facilities;
(2) planning for relocation of moveable facilities;
(3) planning for emergency rescheduling and reassignment of vehicles and personnel.

g. Evaluate potential power outages, fuel shortages, and the limitations they would inflict.

### ISSUE #13: Communication

Normal channels of communication (telephone, electronic media, etc.) will probably be affected by a damaging earthquake. The preparation of alternate facilities is essential for reporting emergency situations, securing aid, manpower, and supplies, warning people of hazardous conditions, reassuring families who are separated, etc.

Recommendation #1: Individual households should be instructed to keep a battery-powered radio in readiness for an emergency.

Recommendation #2: Ham radio operators in local neighborhoods could serve to transmit important citizen messages to emergency operations, relatives, etc. Such local operations could be organized as part of neighborhood self-help programs in response to a prediction.

Recommendation #3: All City police and fire stations and most schools and hospitals are normally equipped with emergency two-way communications. Auxiliary (volunteer?) staffing could be trained to help man the facilities, and relay emergency messages as reported by citizens. People should know the location of their nearest emergency center.

### ISSUE #14: Sewage System

Ruptured sewer lines and septic tanks could contaminate the water system through underground leakage, leading to the spread of disease. Water outages and sewer damage will prevent effective use of household toilets.

Recommendation #1: Continue to locate new sewer lines and septic tanks as far as possible from reservoirs and wells to avoid contaminating water supplies.

Recommendation #2: Following a prediction, reserve a large supply of portable toilets, and educate the people on necessary precautions in improvising temporary toilet facilities. (See Issue #7 for water purification.)

### ISSUE #15: Preparing the Citizens

An informed community will be better prepared to avoid and respond to hazards in their area, and to survive with fewer hardships if lifeline services are disrupted. A well-prepared citizenry will help reduce the post-earthquake demands for emergency services and immediate aid.

Recommendation #1: A comprehensive Public Information Program should be prepared before any major prediction is received, so that it will be ready for immediate release when a warning is issued. The program should include the following components:

a. Inform citizens of the locations of gas lines and hazardous facilities in their area so they may make sensible decisions about travel routes, evacuation plans, and safety in the event of a large earthquake.

b. Distribute special instructions on when and how to turn off home and office utilities at main control points, including necessary precautions for turning them back on.

c. Recommend that all households and businesses acquire flashlights, batteries, and auxiliary cooking devices.

d. Instruct people to assemble ample sanitation supplies for garbage and waste disposal as well as personal hygiene.

e. Encourage households and offices to store drinking water and purification supplies.

(For further details, see "How To Survive An Earthquake.")

Recommendation #2: Encourage citizen evaluation of the City's earthquake and emergency operations plans to point out the needs of individuals and the ways in which they are affected by official planning. Citizen involvement in preparation of the Prediction Response Plan could be especially valuable.

# Chapter 8

# Public Information

## BACKGROUND

Past experience has demonstrated that an immediate demand for many types of information will follow an earthquake prediction reported by the news media. The more authentic the prediction and the greater its magnitude, the more extensive the inquiries have been. In regard to personal safety, people want to know how to protect themselves, their families, homes, and work areas. In addition, they ask for the locations of faults, dams, and other hazards. Some want general information or quick answers. Others prefer extensive detail and are willing to take classes, attend meetings, or do considerable reading.

If a prediction is confirmed by the California Earthquake Prediction Evaluation Council (CEPEC) and prudent preparations are advised, questions are likely to increase. Individuals will ask what kind of assistance is available in coping with relocation, home safety, and strengthening of buildings. Businesses and financial institutions will be concerned with earthquake liability, fire and earthquake insurance, and the economic climate. Demands will be made that the City take action to solve the multitude of potential problems.

On various levels, in many functional areas, there will be a need for responsive public information, advice, and assistance. The City should be prepared to provide timely and informative answers, and to indicate clearly the areas in which assistance is available and those in which people will need to rely on themselves.

## ISSUES AND RECOMMENDATIONS

### ISSUE #1: Providing an Understandable Warning to the Public

If a prediction is validated by CEPEC, the State will issue an official warning, with general advice on preparation for the earthquake. The City should be prepared to supplement the general warning with advice and recommendations geared to (1) the probable effects of the predicted earthquake in the local area, and (2) the degree of earthquake safety that has been achieved in the City prior to the prediction. Warning information must be comprehensible and meaningful to the greatest possible number of people.

**Recommendation #1:** When a scientific prediction is issued before any action is taken by CEPEC, the Mayor could convene an Earthquake Prediction Advisory Committee to (1) assist the Mayor in formulating expectable effects of the potential earthquake for the Los Angeles area, and (2) advise in the formulation of specific warnings and local recommendations to be announced. An effective Earthquake Prediction Response Plan prepared in advance of any prediction could provide a valuable basis for selecting recommendations appropriate to the specific prediction, and would greatly enhance the efficiency and scope of the Advisory Committee's work. (See Chapter 10.)

**Recommendation #2:** Widespread comprehension of the local warning will be promoted by:

a. Using simple or clearly-defined terminology.

b. Transposing percentages and numerical values into intelligible phrases for additional clarity.

c. Preparing maps that incorporate familiar landmarks and verbal descriptions of important information shown.

d. Using graphic illustrations instead of complicated charts and tables whenever possible.

e. Providing the information in all major languages.

**Recommendation #3:** When time permits, the degree to which a warning and recommended preparations have been comprehended might be verified by sampling a cross-section of the population.

### ISSUE #2: Evoking the Appropriate Response from the Public

Earthquake predictions may fail to evoke the appropriate response unless the information is understood by the recipient. A comprehensive information program is essential to communicate effectively (a) the precise meaning of a given prediction, (b) what preparedness measures to take, and (c) how to behave during and immediately after a quake occurs.

Recommendation #1: Earthquake Information Center

a. Establish an Earthquake Information Center which would become operational following a prediction. It could handle the vast majority of calls, referring only complex questions to a specific office in the appropriate department.

b. Prepare and continuously update information for the Center with the participation and cooperation of the respective departments concerned.

c. Consider having this facility function as a "rumor control center" by keeping track of common misconceptions and issuing timely press releases and informational literature to correct them.

d. Encourage the Center to facilitate a sharing of information sources and program ideas among departments.

Recommendation #2: Additional Means of Distributing Information

a. Arrange for the Mayor's field representatives and regional coordinators to circulate general information and pamphlets, channel requests for speakers, discuss proposed or current City programs, and refer people to the proper offices for more detailed information or assistance.

b. Arrange for media coverage through press releases, talk shows and interviews. If care is taken not to exaggerate the extent of danger, accurate media coverage may enhance the credibility of a specific prediction. The information should be repeated often, but in varied forms to prevent the disinterest and apathy that can be produced by monotonous repetition. Avoid immediate drop-off by reducing the frequency of announcements gradually. It is important to reach as many people as possible.

c. City employees who have regular or occasional contact with the public should carry informative pamphlets to be distributed to the citizens. These employees would not be expected to answer technical questions but simply to recommend reading the pamphlet. The text could suggest the Earthquake Information Center as a source of additional information.

d. Institute a city-wide speakers' program and suggest a teaching program for employee training officers in each pertinent department. The departments could then train and assign speakers to appear at community meetings on request. The speaker's program should make special efforts to reach the following segments of the community:

(1) Non-English speaking people

(2) Low-income groups

(3) Labor groups

(4) The handicapped

(5) The elderly

e. Investigate the use of videotape training materials like those employed by the Police Department. Perhaps a videotape prepared for teaching purposes could be made available to all departments.

f. Utilize outside organizations to provide additional public information programs. Organizations that might offer this service are:

Insurance Companies
Home Lending Institutions
Labor Organizations
Women's Service Organizations
  (American Legion Auxiliary)
City Schools (grades 1-12,
  Adult Education)
Red Cross Survival Training Programs
Utility Companies
Colleges and Universities
  (faculty speakers, extension
  courses)

ISSUE #3: Informing Public Officials

Public officials need to be informed regularly on (1) public reactions to the prediction, and (2) the effectiveness of their statements in meeting the needs of the community.

Recommendation: During the prediction period, monitor public opinion through feedback from community groups and knowledgeable, concerned individuals. Keep the City Council, Department heads, and other city officials informed on the results of the monitoring.

## ISSUE #4: Selecting and Educating Community Opinion Leaders

Unless the support of community opinion leaders is attained, it is possible that a valid earthquake prediction will have a less-than-desired effect. The prediction, with subsequent warning and recommendations, might even be undermined by well-intentioned but misinformed community leaders.

### Recommendation #1: Leader Identification

Survey the various major population groups in Los Angeles to identify the opinion leaders whose ideas on earthquake prediction would be most influential. These opinion leaders may be in local government, the mass media, or perhaps the scientific community. At the community level, the opinion leaders may be heads of any of the various civic or religious organizations.

### Recommendation #2: Leader Education

Once identified, leaders should be informed of the problems associated with earthquake prediction. The specific methods of education may involve seminars, individual contact, and conferences. Leader education programs should be developed as soon as possible, and carried out when the appropriate leaders are identified. The ground work for this program should be part of an Earthquake Prediction Response Plan.

## ISSUE #5: Utilizing City Agencies

Many City agencies can contribute productively to public information efforts.

### Recommendations:

1. General: Instruct various City departments to assemble earthquake safety informational materials in preparation for a prediction. Each office should be prepared to conduct special educational programs on short notice. A designated Earthquake Information Officer should have immediate access to training materials, videotapes, and slides. We should also plan a coordinated program using specified department personnel. The advance training of various employees to present occasional talks or programs on earthquakes would provide an immediate talent pool following a prediction.

2. City Library: Could post and distribute pamphlets and supply each branch with relevant literature, such as *Scientific American* and *National Geographic* articles on earthquake prediction, books and brochures on earthquake safety and survival (e.g., *Peace of Mind in Earthquake Country*).

   Could sponsor local programs of group research, book reports, films, etc., on earthquakes.

   Can provide maps and report on the locations and nature of earthquake hazards in the City.

3. Department of Recreation and Parks: Could sponsor survival, first aid, and self-help classes. Could present films and other educational programs on understanding earthquakes and earthquake safety.

4. Department of Building and Safety: Can distribute widely their pamphlet, "Earthquakes--Safety and Survival." Can provide a brochure on the protection of vacant buildings. Can expand their speakers' program on earthquake safety. Could offer to both owners and tenants an efficient call-in service that would identify potentially hazardous buildings, suggest general corrections or precautions, and recommend contacts for further specifics, such as engineering valuations.

5. Fire Department: Could distribute pamphlets such as "Earthquakes--Safety and Survival," and expand speakers' program to cover a wide range of earthquake safety concerns. Could inform public of emergency communications system that would be available to them after a disaster.

6. Police Department: Can provide pamphlets and speakers' programs, as described above, with an emphasis on protecting vacant buildings and preventing looting after an earthquake. Can inform public of emergency communications systems. Can educate public on procedures for possible evacuation and return to evacuated area.

7. Department of Water and Power: Can prepare a factual program on dam location, potential inundation areas, precautions they may have taken in lowering water levels and upgrading dams, etc. Can prepare information on (1) detection of unsafe drinking water and sterilization procedures, (2) safety precautions with electrical appliances, wiring, power poles, etc. Can distribute earthquake safety pamphlets, include brochures with bi-monthly bills, and provide speakers on general earthquake safety.

8. Director of Housing and Housing Agencies: Can supply special information on (1) safety of housing; (2) relocation from unsafe housing; (3) loans or grants for emergency reinforcement, demolition or relocation; and (4) safety precautions for the interior of a building (furniture, bookcases, windows, light fixtures, gas appliances, circuit breakers, etc.). Should work with other departments to develop a pamphlet: "Is Your House Safe in an Earthquake?". The Community Development Agency can refer problems to the appropriate federal or state agency.

9. Planning Department: Can provide pamphlets on earthquake safety at community meetings. Consider setting up the Prediction Information Center in conjunction with their new information facility.

10. Special Program Offices (Senior Citizens, Handicapped, etc.): Can prepare specialized information and procedures for their constituents and arrange for distribution of this material by mail, phone, or speakers' programs.

11. City Council Members: Can send letters to their constituents outlining safety precautions individuals can take and explaining programs and precautions the City has instituted. Can mail or distribute brochures on earthquake safety; can provide their own speakers or can refer citizens to appropriate offices for more specific information.

### ISSUE #6: Discouraging Opportunists

At times of crisis and social disorientation, some individuals "prey" on the insecurities of unwary members of a community. Following a credible prediction, the public must beware of unscrupulous real estate salespersons, unqualified consultants, and contractors who offer inadequate construction repair.

Recommendation: The Mayor could stress publicly the threat of these opportunists, and encourage the media and professional societies to expose any such activity. The State Department of Consumer Affairs could be requested to investigate specific cases.

# Chapter 9

# Emergency Prepardedness

## BACKGROUND

The existing Civil Defense and Disaster Ordinance grants to the Mayor, as head of Civil Defense, the power to invoke emergency procedures. It assigns responsibility to the City departments that will be called in for immediate service, and defines the functions of those departments. Ordering them to suspend normal activities and begin emergency procedures, it allows them to cut through red tape, eliminate cost comparison, to take virtually any steps necessary to expedite their work.

A new Operational Earthquake Response Plan has been drawn up by a Joint Earthquake Planning Committee. Both this plan and the Disaster Ordinance pertain to emergency measures in the case of an actual earthquake.

No plans are currently available for activities that would be needed in response to the prediction of an earthquake. Such plans should include procedures for enhanced readiness, special measures geared to the specific timing, location, and magnitude of the predicted earthquake, and a public information program.

Implementation of an Earthquake Prediction Response Plan would commence when a scientific prediction is validated by the California Earthquake Prediction Evaluation Council (CEPEC), whereas the Earthquake Response Plan would go into effect when an earthquake actually occurs. Integration of the prediction and emergency response plans is essential to avoid duplication, to coordinate efforts, and to maximize efficiency.

The basic objective of earthquake prediction response planning is to establish, prior to the onset of an emergency situation, a framework of authority and a basis for action that will take into account both the socioeconomic advantages and disadvantages of a scientifically based earthquake prediction.

## ISSUES AND RECOMMENDATIONS

### ISSUE #1: Determining Appropriate Prediction Responses

The development of an appropriate response to an earthquake prediction will require some hard decisions involving various levels of social and economic disruption. Such decisions will require sound technical advice, but will be basically political and will require broad support.

Recommendation: An Earthquake Prediction Advisory Committee should advise the Mayor and the Civil Defense and Disaster Board on the significance of specific predictions to Los Angeles and help determine appropriate levels of response to each prediction received. (See Chapter 5, Issue #2.) The Advisory Committee should also assist in the preparation of the City's Earthquake Prediction Response Plan.

### ISSUE #2: Developing a Response Plan

Any meaningful response to an earthquake prediction will result in some level of disruption. Generally, the greater the response to prevent potential loss of life and property, the greater the disruption. Therefore, plans must include various levels of response for varying degrees of confidence that a damaging event will occur.

Recommendation #1: The Civil Defense and Disaster Board should participate in the development of a multi-level earthquake prediction response plan.

Recommendation #2: City staff under the appropriate office should be expanded with the necessary personnel and logistical support to coordinate the development of a response plan.

Recommendation #3: In developing an earthquake prediction response plan, consider the following suggestions:

a. Establish priorities and policy for the long-term situation.

b. Plan for minimum to maximum response levels taking into account the socioeconomic repercussions of various courses of action.

c. Review, update, or develop when necessary:

(1) Maps indicating potential high-risk areas (fire, dam collapse, landslide, hazardous structures, etc.)

(2) Procedures for anticipating distribution of damage and ensuing hazards (e.g., damage maps).

(3) Preparedness plans and post-earthquake capabilities of organizations and institutions operating lifeline systems (hospital, power, natural gas, sanitation, communications, transportation facilities).

(4) Staffing, operation, and communications capabilities of the Emergency Operating Center (EOC) and other headquarters.

(5) Mutual aid agreements.

(6) Means for informing the public.

(7) Emergency service organizations and their responsibilities.

(8) Legislation and local ordinances.

d. When a prediction is issued, initiate separate workshops for each emergency organization in which they review their respective post-earthquake actions. Although many of the following tasks are in process or already have been completed in general terms, they will need to be examined in closer detail when the specific characteristics of a particular prediction (e.g., time, location, magnitude, and anticipated damage) are known.

(1) Assign responsibility to service units and personnel for specific actions indicating precisely when, where, how, and with what resources actions are to be accomplished.

(2) Evaluate existing capability for performing the specified actions and, where appropriate, identify measures and resources to improve capability.

(3) Identify measures that will reduce earthquake losses, e.g., moving equipment to safer locations.

(4) Determine activities and services that could be deferred or curtailed, freeing funds for emergency preparations.

(5) Develop plans to be implemented when a short-term warning is issued, e.g., evacuation.

(6) Determine requirements and prepare procurement orders for needed equipment and supplies.

Recommendation #4: The following plans of action suggested by the State Office of Emergency Services should be evaluated and augmented for inclusion in any prediction response plan.

a. Consider actions to reduce risk of hazardous structures and locations, e.g., removal, strengthening, prohibition of occupancy.

b. Expand fire prevention programs and abatement of fire hazards to meet the specific problems of a predicted earthquake.

(1) Augment firefighting resources; prepare mobilization instructions.

(2) Survey community for high-risk fire areas, modifying or confirming fire contingency plans as appropriate.

c. Improve the capability of emergency service organizations.

(1) Recruit, train, and assign personnel as needed.

(2) Review mobilization instructions.

(3) Bring the EOC and other headquarters to full readiness; provide auxiliary power, and augment communications.

(4) Arrange for, and prepare for use, facilities selected for staging areas, mass care centers, etc.

(5) Procure necessary equipment and supplies.

d. Improve readiness in potential dam and tsunami flood areas.

(1) Check on evacuation plans, warning systems.

(2) Arrange for transfer of key facilities.

(3) Establish engineering procedures to determine potential extent of damage.

(4) Consider other methods to alleviate emergency (e.g., lowering water level).

e. Improve readiness and capability of lifeline systems, resource agencies, and essential industries.

(1) Identify measures to reduce earthquake losses and disruption of services.

(2) Activate standby agreements for lifelines systems.

(3) Consider relocation of resources to areas outside the high-risk area.

(4) Prepare instructions for mobilizing medical personnel and resources.

(a) Expand stocks of drugs, medicines, and sanitation supplies.

(b) Check readiness of hospitals to discharge or move patients and expand bed capacity; suggest deferring elective surgery.

f. Brief key government officials and private sector leaders on planned responses, as prescribed.

## ISSUE #3: Preparing City Hall

Recommendation: Instruct the General Manager of each City department to develop and implement an earthquake awareness program within his respective department. Such programs should consider the impact of an earthquake prediction upon the work environment of management and operational personnel. Contingency plans should be developed within each department for maximum efficiency in implementing appropriate responses and preparing for the anticipated quake.

## ISSUE #4: Preparing the Citizens

In a disaster the size of an earthquake, emergency assistance will be concentrated in the areas of greatest damage. Less severely hit areas will be isolated, with little or no outside aid for a period of several hours to several days. Because of the likely complications of street hazards, limited access, and traffic congestion, people should be discouraged from driving.

Recommendation #1: Encourage "self-help" programs based in the family, the neighborhood, or the local community. Through these programs, people could begin to deal with the most acute problems until outside services (fire, medical, housing, food) become available.

Recommendation #2: A "neighborhood self-help" kit should be prepared to provide information for a neighborhood or family to prepare and coordinate appropriate supplies, special training, and contingency plans to help them best survive the immediate aftermath of an earthquake.

Recommendation #3: Police, Fire Department, and other City-sponsored public education sessions should be supplemented to provide special advice and assistance to neighborhood and community groups who want to set up their own "self-help" programs. Through meetings and phone response, advice can be tailored to the specific environment and capabilities of each group. "Self-help" kits could be demonstrated and distributed at public education programs. (See also Chapter 8.)

Recommendation #4: To eliminate the need for driving, urge people to seek help within their immediate neighborhood, preferably from pre-arranged centers within walking distance.

# Chapter 10

# Earthquake Prediction Response Plan

We now realize that the credible prediction of a major earthquake could set in motion a series of economic and social changes and a demand for information and action to which we are not yet prepared to respond. Without an organized and well thought-out plan of response, the opportunity to save lives and property, to reassure and prepare citizens, to safeguard essential facilities and to maintain a viable local economy would probably be lost. The Task Force considers the best coordinating and planning mechanism for prediction preparations to be an Earthquake Prediction Response Plan. Many topics and recommendations for incorporation in the plan are included in the preceding chapters. This section deals with some general issues and overall organization pertinent to the preparation of a Response Plan.

## TIME FRAME AND LEVEL OF RESPONSE

A highly versatile response plan is needed if the City is to be prepared to deal with the many variables that would comprise a specific prediction. The magnitude, lead time, location, and probability (confidence level) would each play a role in the selection of an appropriate plan of action. For instance, a three-year lead time would allow the upgrading of hazardous structures, whereas a three-day prediction may call for selective evacuation of hazardous buildings.

### Magnitude and Location

The two variables of magnitude and location can be combined into one parameter -- estimated intensity, which would indicate the general degree of shaking and ground movement that is likely to be experienced in Los Angeles during the predicted earthquake. This would help distinguish, for example, between a response to a Magnitude 6 predicted for the San Bernardino area, and a Magnitude 6 in the San Pedro area. It would also allow different levels of response, as appropriate, for different parts of the City, thereby focusing efforts in areas of greatest need. At a basic level, intensity would be determined by both the magnitude of the predicted earthquake and the relative distance from the predicted location. At a higher level of refinement, the designation of anticipated intensity could incorporate areas inherently more susceptible to earthquake damage: locations of expected fault movement or potential landslide reactivation, soil liquefaction-prone areas, and locations of "soft" ground, such as young valley deposits. Modified Mercalli intensities need not be assigned in either case, but more general designations of "low, moderate, high and very high," relating to expectable damage levels, could be used.

### Probability or Confidence Level

As they do in weather and hurricane predictions, scientists recognize the need to assign a probability that the predicted earthquake will occur. Unfortunately, probability estimates require some statistical basis of experience, and the sparcity of existing data on monitored earthquakes does not yet allow statistical treatment. In the meantime, a scientist instead may assign a "confidence level", related to (1) his/her estimation of the reliability of the prediction model being applied, and (2) how well the data fits the model.

### Response Level

The confidence level or probability can be combined with intensity in a simple graph outlining an appropriate level of response (Figure 1). The greater the intensity and the higher the confidence level, the higher the level of response that would be indicated. In this example, four levels of response are possible. General descriptions appropriate to each level are as follows:

Minimal response - Where a low intensity or low confidence level is assigned, the threat of the predicted earthquake should not be reinforced, but the Mayor and the City could respond to any public concern by providing information and explaining programs that will better prepare the community for any earthquake. This level of response would also be appropriate where a prediction is not verified by CEPEC, but continues to generate public concern.

Limited response - Where the perceived threat is at a moderate level, a limited response could intensify City earthquake safety programs, encourage similar actions in the private sector, and provide a broad-based public information program to better prepare the citizens and prevent unnecessary economic strain and social apprehension. Aside from selective acceleration of existing earthquake abatement programs as time permits, the only mandatory responses would be at governmental levels; most or all preparations in the private sector would be voluntary.

Moderate response - Some mandatory programs in the private sector could be added in cases where potential savings in life and property are considerable; government response should be thorough and deliberate; a wider range of voluntary efforts could be encouraged; economic reactions should be monitored and counteracted where appropriate.

Full response - Where the threat of a destructive earthquake is very real, more extreme measures should be considered, such as: evacuation of selected buildings or areas; compulsory inspection and upgrading of all petroleum storage facilities; closing of selected bridges and overpasses; enactment of new building codes to correct problems related to structural ties and mechanical equipment in existing buildings; undertaking a highly-coordinated and intensive citizen preparedness program; seeking Federal disaster assistance; and initiating specific programs to counteract non-productive economic reactions.

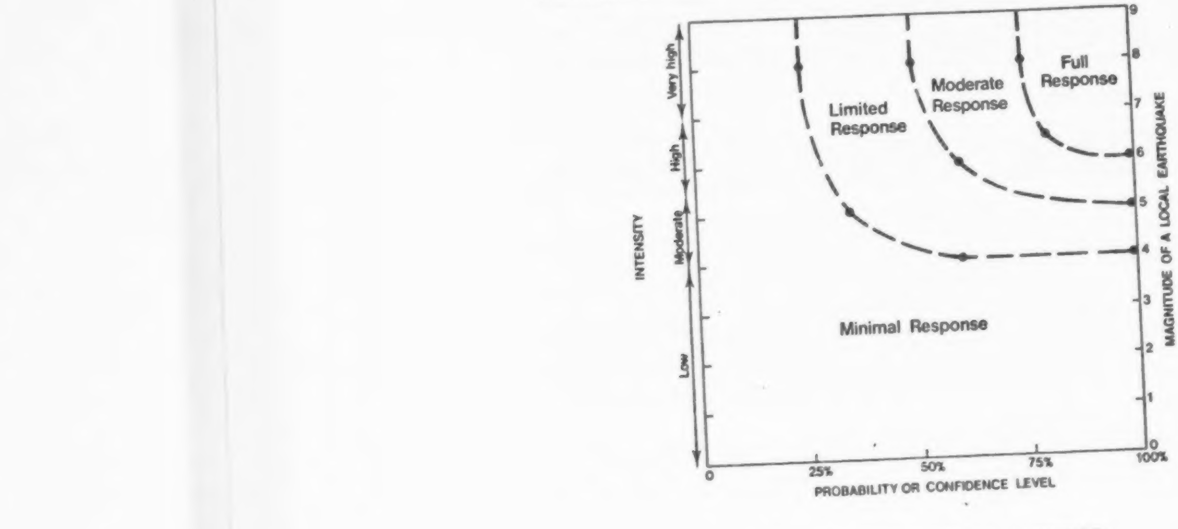

Figure 1. Suggested format for determing an appropriate response level for a specific prediction.

Time Frame

Once a response level is selected, the specific components of the response should be geared to the lead time available before the predicted event. A simple chart (Figure 2) illustrates the range of appropriate actions. Plans for each time frame should be available in advance of a prediction, so that they can be implemented in a responsive and timely fashion. Where City Council action is required, appropriate authority should be obtained, or conceptual groundwork laid in advance so that the long process of initiation and debate can be expedited if necessary.

An outline of actions appropriate for each time frame will be needed for each area of concern -- utilities, lifelines, buildings, public information, economic stability, etc. -- as each topic will require different solutions. As the time of a predicted earthquake nears, the operating response may need to shift from longer-term activities to shorter-term activities selected from the next time frame.

| RESPONSE LEVEL | LEAD TIME | | |
|---|---|---|---|
| | Long (years) | Intermediate (months to 1.5 yrs.) | Short (days) |
| Minimal | Public education and information programs as appropriate. | | |
| Limited | Initiate and accelerate selected seismic safety measures within City Government. | Accelerate or modify selected features of existing City programs, inspect City facilities, encourage private actions. | Emergency crews on alert, prepare and educate citizens and employees, close hazardous public buildings. |
| Moderate | Initiate and acclerate selected codes for upgrading of private and public facilities. | Acclerate codes for upgrading, provide relocation assistance, inspect critical facilities. | Adjust work and vacation schedules, close or evacuate selected facilities. |
| Full | Enact codes for mandatory upgrading of hazardous facilities. | Acclerate codes for upgrading, initiate mandatory relocation programs. | Intensive education, selected evacuation, emergency crews on duty, close vulnerable bridges and overpasses. |

Figure 2. Range of appropriate actions with varying response levels and lead times (simplified example.)

## GENERAL STRUCTURE OF A RESPONSE PLAN

A key component of any Earthquake Prediction Response Plan will be the organizational framework for producing, updating and carrying out the plan. Because of the wide variety of topics that need to be dealt with (economics, social and psychological stability, broad-based public information programs), the group preparing the plan will need to include resources beyond the traditional make-up of the Civil Defense and Disaster Board. It is recommended that business and community leaders, utility representatives, sociologists, geologists, seismologists, engineers and architects participate actively in the preparation of the response plan. Special material for the handicapped, the elderly and foreign-speaking people will need to be developed, and agencies familiar with these constituencies should be invited or recruited to participate. Several scientists in social, engineering, economic and governmental fields have conducted years of research in the areas related to earthquake prediction; they would probably be very willing to share their insights and participate in formulating various components of the plan. The Civil Defense and Disaster Board would also have an important role in preparing a response plan, as many of the components of the plan would come under its authority for implementation.

The response plan itself will need to establish a structure for 1) evaluating the local significance of any specific prediction, 2) determining the appropriate response, and 3) expeditiously carrying out the various aspects of the chosen response. It will also need to identify ongoing goals that would make the plan more effective, and to provide a mechanism for periodic review and updating of the plan as new programs, options and legal authority become available. Some basic suggestions for accomplishing these objectives are outlined below.

## Earthquake Prediction Advisory Committee

Outside resource people will probably be needed to help evaluate the significance of a specific prediction for the local area. A committee composed of seismologist, geologist, structural engineer, legal and business members should be established to advise the Mayor and other personnel on the significance of each prediction and the types of response that would be appropriate. The committee could meet immediately following the announcement of any relevant prediction (presumably prior to any finding of CEPEC) and provide an initial, informal assessment on an interim basis. This would 1) help prepare the Mayor and other staff members to respond to initial press and citizen inquiries, and 2) prompt the initiation of any special preparations that may be advisable in anticipation of a possible confirmation of the prediction by CEPEC. If the prediction were not confirmed by CEPEC, no additional meetings may be necessary for that prediction, and a minimal response could be initiated as per the response plan. If the prediction were validated by CEPEC, the Advisory Committee would be assembled again to perform several tasks: 1) clarify the meaning of the various components of the prediction (time, location, confidence level, etc.), 2) provide a preliminary estimate of the intensity that would be experienced within the City, 3) help select the appropriate response level, and 4) generally clarify any potential misconceptions of what the prediction does and does not mean. The committee could also provide advice on the appropriate mechanism and methodology for producing more specific intensity estimates and damage maps within the time frame presented by the prediction. After this initial effort, the committee or individual members could be reconvened as needed to provide further assistance to the Mayor or to specific City boards and agencies. The committee would not necessarily be responsible for specifying the full slate of appropriate responses for the predicted earthquake, nor would they be directly involved in implementing the selected response. However, they might help monitor the effectiveness of the chosen response and suggest adjustments as warranted.

## "Prediction Response Board"

An operating group of City and public representatives will be needed to select a specific program of action at the general response level warranted by the prediction. All major operating departments of the City should be represented, as well as business, utilities and community leaders. The individuals responsible for an earthquake prediction information center could be valuable members of this group. The "response board" would also coordinate and oversee all major components of a response effort, including governmental coordination at the local, State and Federal levels. As an alternative, a "Prediction Response Coordinator" could be assigned full-time to assist and coordinate the many components, and actual convening of the Board could be kept to a minimum.

## Program Development, Legislative Action, Research and Update

During the preparation of the Prediction Response Plan, programs will need to be developed for such aspects as the centralized Earthquake Prediction Information Center, a broad-based public education and "self-help" program, the monitoring of economic repercussions, and achieving the cooperation and consensus of other jurisdictions. Legal questions can be further investigated, and appropriate legislation should be sought. Special working groups could help establish programs for correcting structural hazards and safeguarding lifeline facilities, as suggested in earlier chapters, and various areas of research could be sponsored or encouraged.

By the time the first Earthquake Prediction Response Plan is prepared, several of the major questions posed in earlier chapters may be answered, but others will still stand. The Response Plan should therefore include goals for resolving the remaining problems, so that those objectives can be addressed in ongoing City efforts. The Response Plan should then be reviewed at predetermined intervals of a year or two, and the results of the ongoing research, legislation, and program development activities should be reflected in appropriate revisions to the plan.

# Glossary

| | |
|---|---|
| thquake | An earthquake of Richter magnitude 5.5 or greater. |
| | A zone of weakness in the earth's crust where movement between two crustal blocks has taken place. |
| | The strength of an earthquake as felt at any given location, expressed in terms of the Modified Mercalli scale. |
| | The time between receipt of the prediction and the anticipated date of the earthquake. |
| izons | Short term - up to one month.<br>Intermediate term - one month to one year.<br>Long term - one or more years. |
| | The sudden and temporary transformation of loose, water-saturated soil to a liquid mass when subjected to shock or strain. |
| | The energy released by an earthquake at its focus, as measured on the Richter Scale. |
| | A statement of the time, magnitude and location of an impending earthquake. An indication of confidence level or probability of the predicted event is also desirable. |
| | A standing wave oscillation on the surface of a lake or semi-enclosed body of water. |
| | A spreading wave generated by landslide, soil failure, seiche, explosion or falling material. |
| | The length of time available before a predicted earthquake. (See Lead Time Horizons.) |
| | The period of time during which the predicted earthquake is expected to occur. |
| | Seismic sea waves of long wave length, generated by some earthquakes and underwater landslides. |
| Masonry | Stonework or brickwork lacking the supplemental steel reinforcing bars which help tie the masonry together and add vertical support for overlying parts of the structure. |
| | An official recommendation that normal life routines should be altered for a time to deal with an impending danger. It identifies a situation as dangerous and advises its recipients that the risk to life and property can be reduced by an appropriate response. |

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CITY OF LOS ANGELES
CALIFORNIA

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MAYOR

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DEPARTMENT OF
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January 5, 1979

S79.1401.1

Honorable Building and Safety
Committee of the City Council
Room 395, City Hall

ATTN: CHARLOTTE KRAALS
Legislative Assistant

PROPOSED CODE AMENDMENTS REGARDING EARTHQUAKE
HAZARDOUS BUILDINGS
(C. F. NO. 73-721 and 74-4395)

The Special Earthquake Safety Study Committee has recently completed its study of a comprehensive earthquake safety ordinance relating to "Earthquake Hazard Reduction In Existing Buildings". During this study period, the Department of Building and Safety has been coordinating and monitoring the progress of the committee's work and has participated in its development of the proposed ordinance. Life safety was the basic philosophy undertaken by the study committee throughout its deliberation. The committee combined sound engineering judgement with the additional knowledge gained from a unique testing program on actual unreinforced masonry buildings which was performed to supplement existing test data already researched. The study committee elected to limit the scope of the ordinance by revising the exception for detached residential buildings from two to four units.

To accelerate the replacement of earthquake hazardous buildings that may be demolished as a result of the proposed ordinance,

AN EQUAL EMPLOYMENT OPPORTUNITY — AFFIRMATIVE ACTION EMPLOYER

the study committee also recommended an amendment to the Planning and Zoning Code. This amendment would permit a new earthquake resistant building, which takes the place of an existing earthquake hazardous building, to utilize the same nonconforming use, parking and yard privileges previously enjoyed by the existing building.

The Department of Building and Safety has reviewed and examined the proposed ordinance and concurs with its purpose and objective, and recommends its quick adoption. To implement and enforce a 10-year Earthquake Hazard Reduction Program for the 8,000 buildings already identified to be within the scope of the proposed ordinance, this Department proposes a graduated three phase staffing plan to allow for the expanding nature of enforcement. A staff of 10 would be required for the initial 16 months of the program. Staffing would then be increased to 23 for the next year and finally increased to 31 for the following years as the program reaches its optimal capabilities. It is anticipated a reverse phasing plan would then be put into effect as the program neared completion.

Studies by this Department reveal that the revenue received from plan check and buildng permit fees will off set all direct costs. The average staffing cost is estimated at $521,290 per year, while the average revenue received from building permit and plan checking fees is estimated at $523,280 per year. The revenue estimate is based on a construction cost of $6.00 per square foot and a building inventory of 90 million square feet.

## DEPARTMENT RECOMMENDATION:

In order to accomplish these objectives during a 10 year program, the Department of Building and Safety strongly recommends that your Committee take the following actions:

1. Recommend approval of the proposed Ordinances contained in the Special Earthquake Safety Study Committee Report dated December 14, 1978 and request the City Attorney to prepare the official ordinances for presentation to the City Council with this report.

2. Recommend, subject to the approval of the Mayor, that the City Council grant resolution authority to the Department of Building and Safety for the following positions for the balance of the current 1978-79 fiscal year:

| No. | Class Code | Title | Function |
|---|---|---|---|
| 4 | 4211 | Building Inspector | Field Inspections |
| 1 | 4213 | Sr. Building Inspector | Working Field Supervisor |
| 1 | 9425 | Sr. Struc. Engineer | Program Supervision and Complex Structural Evaluations |
| 1 | 7956 | Struc. Engineer | Complex Plan Checking |
| 1 | 7954 | Sr. Struc. Engr. Assoc. | Difficult Plan Checking |
| 2 | 1321 | Clerk Steno | Office |
| 10 Total | | | |

3. Recommend, subject to the approval of the Mayor, that $78,340 be transferred from the Reserve Fund to the Unappropriated Balance and appropriated therefrom to the following accounts within the Department of Building and Safety for the last four months of the current 1978-79 fiscal year.

| | | |
|---|---|---|
| 101 - Salaries General | | $74,528 |
| 212 - Printing and Binding | $ 477 | |
| 331 - Transportation Expense | 1660 | |
| 601,604 - Office and Administration Expense | 347 | |
| TOTAL EXPENSES | | $ 2,484 |
| 730 - Office Furnishings and Technical Equipment | | $ 1,328 |
| TOTAL APPROPRIATION | | $78,340 |

4. Recommend to the City Council that the graduated three phase staffing plan as described in this report, to allow for the expanding nature of the enforcement, be approved in concept.

JACK M. FRATT JAN 9 1979
General Manager

jbg

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S78.1709.1

December 19, 1978

Mr. Calvin S. Hamilton, Director
of the Planning Department
Room 561-C, City Hall

ATTN: Gary Morris
Environmental Review Section
Room 655, City Hall

INITIAL STATISTICAL REPORT FOR ENVIRONMENTAL IMPACT REPORT OF PROPOSED EARTHQUAKE HAZARD REDUCTION ORDINANCE
(C. F. No. 73-721 and 74-4395)

This report represents the initial portion of the statistical data that William Heeb of your department requested by letter dated November 6, 1978. The report consists of:

1. A Summary of the Ordinance,
2. Five Statistical Charts of Survey Data,
3. Definition of Use Booklet,
4. Two Additional Copies of the Ordinance, Booklet and Charts.

Although the actual survey and computerized data compilation is not yet finalized, it is estimated that there are 635 pre-1934 unreinforced masonry buildings in Council District 14 and 8,000 within the City's boundaries. Field identification of all the buildings will be completed by January 1, 1979, and the computer cataloging should be completed by February 1, 1979. The Building and Safety Committee of the City Council will consider the proposed ordinance together with reports from the Earthquake Safety Study Committee and the Department of Building and Safety on January 16, 1979.

Earl Schwartz, of this department, has been coordinating results of the survey program with Bill Heeb and Ed Orth of your department, and he will continue to forward the necessary survey data as it becomes available.

JACK M. FRATT
General Manager

# SUMMARY OF ORDINANCE

Council File Numbers: 74-4395 and 73-721

## 1. DESCRIPTION OF ORDINANCE

The ordinance as developed by the Earthquake Safety Study Committee will add Division 68 to the Building Code, and would require unreinforced masonry bearing wall buildings constructed prior to October 6, 1933, to meet minimum earthquake standards.

## 2. OBJECTIVES OF THE ORDINANCE

The objective of the ordinance is to reduce the earthquake hazards in existing pre-1934 unreinforced masonry bearing wall buildings by requiring such buildings to be strengthened.

## 3. WHERE WOULD THE ORDINANCE APPLY

The ordinance would apply on a city-wide basis.

## 4. HOW THE ORDINANCE WOULD OPERATE

Following designated priorities, the Department of Building and Safety would order building owners to have their buildings structurally analyzed by a licensed engineer or architect. Structural deficiencies discovered by the analysis would be structurally altered to meet specified minimum standards within three years of notification. Appeal procedures are established. Some owners may elect to demolish their buildings as a method of compliance.

## 5. EXISTING CONDITIONS

Approximately 8,000 pre-1934 earthquake hazardous unreinforced masonry buildings exist in the City of Los Angeles. These buildings were not required to meet any earthquake standards when they were built and experience has shown that such buildings are subject to collapse in the event of a moderate to strong earthquake. The present building code has no earthquake standards for existing buildings.

## 6. BENEFICIAL ASPECTS OF THE ORDINANCE

The ordinance will promote public safety and welfare by reducing the risk of death or injury that may result from the effects of of earthquakes on unreinforced masonry bearing wall buildings constructed before 1934. It is estimated that in addition to saving an estimated 7,000 lives and preventing 26,000 casualties, hundreds of millions of dollars worth of building inventory would be saved if the proposed earthquake hazard reduction program is completed.

### 7. ADVERSE IMPACTS OF THE ORDINANCE

The reconstruction work resulting from code compliance might cause some disruption to the tenants of the affected buildings. Some buildings may be demolished.

### 8. RELATIONSHIP TO PLANS, LEGISLATION, PENDING PROJECTS, ETC.

The proposed ordinance conforms with the Seismic Safety Plan, which is a portion of the general plan of the City of Los Angeles. The proposal does not contradict or conflict with known proposed plans, legislation, or projects, currently undertaken by the City of Los Angeles.

CHART NO. 1-A*

ASSESSED VALUATION DATA FOR COUNCIL DISTRICTS 9(1) & 14

FROM LUPAMS FILE(2)

| PRIMARY USE | NO. OF BLDGS. | | BUILDING VALUATION(3) | | LAND VALUATION(3) | | SQUARE FOOTAGE(4) | |
|---|---|---|---|---|---|---|---|---|
| | CD 9 | CD 14 | CD 9 | CD 14 | CD 9 | CD 14 | CD 9 | CD 14 |
| Amusement | 0 | 3 | 0 | 118 | 0 | 67 | 0 | 49 |
| Apartments | 2 | 16 | 262 | 703 | 260 | 376 | 78 | 173 |
| Churches | 1 | 7 | 104 | 229 | 106 | 99 | 16 | 40 |
| Private Garages | 0 | 2 | 0 | 24 | 0 | 26 | 0 | 6 |
| Public Garages | 2 | 17 | 31 | 532 | 398 | 621 | 28 | 117 |
| Hospitals | 0 | 1 | 0 | 9 | 0 | 54 | 0 | 9 |
| Hotels | 18 | 2 | 1,397 | 117 | 2,779 | 52 | 508 | 33 |
| Manufacturing | 2 | 51 | 46 | 1,398 | 196 | 1,574 | 50 | 527 |
| Offices | 10 | 16 | 1,762 | 476 | 2,427 | 314 | 160 | 88 |
| Retail Stores | 15 | 122 | 849 | 2,861 | 2,563 | 2,785 | 208 | 603 |
| Restaurants | 13 | 21 | 692 | [illegible] | 2,066 | 380 | 103 | 87 |
| Theaters | 4 | 0 | 165 | 0 | 806 | 0 | 35 | 0 |
| Warehouses | 20 | 12 | 1,434 | 409 | 4,460 | 403 | 518 | 97 |
| TOTALS | 87 | 270(5) | 6,743 | 7,319 | 16,061 | 6,751 | 1,704 | 1,829 |

*Update January 8, 1979

(1)Census Tracts 2077 & 2078

(2)August 1977 data

(3)Thousands of dollars

(4)Thousands of square feet

(5)Represents 43% of the buildings in the Council District

## CHART 2
## PRELIMINARY EARTHQUAKE SURVEY DATA

| ESTIMATED PRIMARY USE | NUMBER OF BUILDINGS* |  | SQUARE FOOTAGE [1] |  |
|---|---|---|---|---|
|  | Council District 14 | All Council Districts | Council District 14 | All Council Districts |
| Amusement | 7 | 66 | 10 | 85 |
| Apartments | 96 | 1,067 | 53 | 1,743 |
| Churches | 12 | 108 | 9 | 77 |
| Private Garages | 2 | 66 | 1 | 61 |
| Public Garages | 32 | 371 | 16 | 207 |
| Hotels | 5 | 196 | 7 | 431 |
| Manufacturing | 128 | 884 | 188 | 975 |
| Office | 32 | 463 | 37 | 585 |
| Public Buildings | 8 | 82 | 9 | 50 |
| Retail Stores | 198 | 1,495 | 104 | 964 |
| Restaurants | 24 | 226 | 21 | 200 |
| Theatres | 5 | 32 | 4 | 31 |
| Warehouses | 30 | 804 | 75 | 1,292 |
| Others | 4 | 26 | 12 | 36 |
| Totals | 583 | 5,886 | 546 | 6,737 |

* Based on 74% of the buildings - the final total should be approximately 8,000

[1] Square Footage in 10,000 sq. ft.

## CHART NO. 3

### PRELIMINARY DATA SUMMARY

| CATEGORY | COUNCIL DISTRICT NO. 14 | ALL COUNCIL DISTRICTS |
|---|---|---|
| No. of Apartments(1) | 792 | 29,217 |
| No. of Guest Rooms(1) | 220 | 15,630 |
| Vacancy Factor(2) | 8.0% | 4.7% |
| No. of Employees(1) | 10,555 | 54,521 |
| No. of Occupants(1)(3) | 79,531 | 808,856 |

(1) Based on 6,231 Buildings
(2) Based on 5,898 Buildings
(3) Capacity per L.A.C. Bldg. Code

## CHART NO. 4

### ESTIMATED PRIORITY RATING BREAKDOWN*

| RATING | NO. OF BLDGS. | % OF TOTAL |
|---|---|---|
| I | 87 | 1% |
| II | 1834 | 23% |
| III | 5127 | 64% |
| IV | 952 | 12% |
| | 8000 | 100% |

*Based on 74% of the Buildings

## CHART NO. 5

### PROJECTED USE BREAKDOWN*

| | |
|---|---|
| 3,606 | Commercial Buildings |
| 2,294 | Industrial Buildings |
| 1,450 | Apartment Buildings |
| 266 | Hotel Buildings |
| 112 | Public Buildings |
| 272 | Others |
| 8,000 | Total Buildings |

### CHART NO. 6
### SEISMIC SURVEY SHOWING AFFECTED BUILDINGS BY COUNCIL DISTRICTS*
### DECEMBER 29, 1978

| COUNCIL DISTRICT | NO. BLDGS. IDENTIFIED | % OF TOTAL IDENTIFIED |
|---|---|---|
| 1 | 33 | 0.4% |
| 2 | 55 | 0.7% |
| 3 | 49 | 0.6% |
| 4 | 996 | 12.7% |
| 5 | 309 | 3.9% |
| 6 | 255 | 3.2% |
| 7 | 57 | 0.7% |
| 8 | 437 | 5.6% |
| 9 | 2,996 | 38.1% |
| 10 | 896 | 11.4% |
| 11 | 70 | 0.9% |
| 12 | 2 | 0.0% |
| 13 | 783 | 10.0% |
| 14 | 635 | 8.1% |
| 15 | 290 | 3.7% |
| TOTALS | 7,863 | 100.0% |

*Represents a hand count of inspection results.

December 14, 1978

Honorable Building and Safety
Committee of the City Council
Room 252, City Hall

ATTN: Charlotte S. Kraals
Legislative Assistant

PROPOSED CODE AMENDMENTS REGARDING EARTHQUAKE HAZARDOUS BUILDINGS
(C. F. 74-4395 & 73-721)

Earthquake hazardous buildings were considered under Council Files 74-4395 & 73-721 and were referred to the Building and Safety Committee on January 24, 1977 for further study and development of a new comprehensive earthquake safety ordinance. In March 1977, Mr. R.J. Williams (Immediately retired manager of the Department of Building & Safety), was appointed to Chair a Special Earthquake Safety Study Committee under this council file. After almost two years of study involving several hundreds of hours of work and many meetings with recognized experts, organizations, owners, private industry, related businesses, the Department of Building and Safety, and interested individuals, a pioneer code (the first of its kind known), was developed as requested and a study was made on the impact of implementation of the proposed ordinance.

Testimony received from seismologists and geologists at various public hearings suggest that the likelihood of a major earthquake occuring in the Los Angeles basin in the next 20 years is quite large. In addition, it may be many years before the full significance of the "Palmdale Bulge" has been fully assessed by the United States Geological Survey. Major policy and program development commitments outlined in the Seismic Safety Plan adopted by the City Council in September of 1975 call for the establishment of a systematic time-phased program for the abatement of pre-1934 unreinforced masonry buildings. In a recent report by the task force selected by Mayor Bradley relating to earthquake prediction, pre-1934 unreinforced masonry buildings were pinpointed as posing the greatest life hazard in an earthquake. For these reasons, it is strongly recommended that positive action be taken quickly to avert the collapse of thousands of unsafe buildings should a major earthquake strike the City of Los Angeles.

The proposed ordinance to add Division 68, "Earthquake Hazard Reduction In Existing Buildings" to the Los Angeles Municipal Code, was developed under Sub-committee Chairman Raymond Ziegler and is included in this report as Exhibit "A". It includes the following features:

1. Applies to unreinforced masonry bearing wall buildings constructed prior to code requirements of design for earthquakes. (October 6, 1933). Detached residential buildings with less than 5 dwellings units are exempted.

2. Recognizes the resistance of existing construction if still structurally sound. This will minimize resulting problems.

3. Establishes a phased compliance program that would extend over a 10 year period for completion allowing for extensions of time and appeals on hardship cases. Notification for compliance would be based on priority system however compliance would not be required to commence prior to:

   (a) Six months for High Risk Buildings (large open buildings with 100 or more occupants used more than 20 hours per week)

   (b) Eighteen months for Medium Risk Buildings (any buildings with 20 or more occupants if not an essential building or a high risk building)

   (c) Five years for Low Risk Buildings (all other buildings if not an essential building)

   (d) Essential buildings required for emergency use immediately following an earthquake (hospitals, communications centers, fire stations, police stations, etc.) would have to commence compliance as soon as notified.

This proposed code should greatly reduce the risk of death or injury at a minimum cost. A report by the United States Geological Survey predicts catastrophic results if a major earthquake hits the Los Angeles area and could result in as many as 12,000 fatalities and 48,000 casualties. It has long been recognized that the major single source of casualties has been in unsound, unreinforced masonry buildings, such as those that the proposed ordinance addresses itself to.

In an effort to hasten the replacement of hazardous buildings that may be demolished as a result of the proposed ordinance, the Earthquake Safety Study Committee requested that the Planning Department draft an amendment to the Planning and Zoning portion of the Los Angeles Municipal Code which would permit the rapid replacement of earthquake hazardous buildings non-conforming as to use, yards, or parking with new earthquake resistant buildings of similar size having the same non-conforming use, parking, and yard privileges. This proposal is included as Exhibit "B".

The Impact Evaluation Subcommittee was chaired by Mr. Douglas Deardon and their final evaluation is contained in the attached Exhibit "C". Their meetings included owner of buildings affected, financing institutions, insurance agencies and interested individuals. The report addresses itself to: 1) Cost of Repair, 2) Available Financing, 3) Liability Insurance, 4) Relocation of Residents, 5) Effects on Residential Tenants and 6) Affect on City Taxes.

At the time of submittal of this report, the Department of Building and Safety reports the field survey to identify the affected buildings under Council File 74-4395 to be approximately 95% complete with a scheduled completion date of January 1, 1979. The projected estimate of buildings affected are as follows:

| | |
|---|---|
| 3,606 | Commercial Buildings |
| 2,294 | Industrial Buildings |
| 1,450 | Apartment Buildings |
| 266 | Hotel Buildings |
| 112 | Public Buildings |
| 272 | Others |
| 8,000 | Total Buildings |

Although final cost estimates are incomplete, preliminary studies suggest the following average compliance cost under the proposed ordinance would be as follows:

5.00$/sq. ft. for Apartment-Hotel Buildings
6.00$/sq. ft. for Commercial Buildings
5.50$/sq. ft. for Industrial Buildings
6.00$/sq. ft. for Other Buildings

Using the United States Geological Survey statistics for a major earthquake in the Los Angeles Area, and assuming that 70% of the losses would be within the Los Angeles City limits, the following generalized estimates are made:

| Deaths | Casualties | |
|---|---|---|
| 8,500 | 34,000 | With no program |
| 1,500 | 8,000 | With completed program |

Using the above estimated strengthening cost, a major earthquake in the area would structurally damage an estimated 2/3 of the affected buildings with no program and would cause some structural damage to an estimated 1/4 of the buildings after a completed program. Calculations will show that in addition to saving an estimated 7,000 lives and preventing 26,000 casualties, more than 900 million dollars worth of building inventory could be saved if the proposed Earthquake Hazard Reduction Program is completed.

Even though these are very generalized estimates based on a major earthquake, it should be noted that a completed Earthquake Hazard Reduction Program for Existing Buildings would dramatically reduce the number of deaths and casualties as well as the amount of monetary damage to such buildings.

In as much as evidence previously submitted to your committee and to the City Council under this file has indicated that earthquakes of moderate, strong, or major proportions could strike the City of Los Angeles at any time, it is strongly recommended that the following action be taken:

1. That the attached proposed ordinances, relating to Earthquake Hazard Reduction and Replacement of Earthquake Hazardous Buildings, be approved by your committee and sent to the City Council along with the appropriate Environmental Report.
2. That your committee recommend to the City Council adequate staffing authority and funding to the Department of Building and Safety for implementation and enforcement of the estimated 10 year program.
3. That the Chief Legislative Assistant and the Department of Community Development continue their efforts to seek financial assistance to rehabilitate such buildings.

Respectfully Submitted,

R. J. Williams

R. J. WILLIAMS
Chairman Earthquake Safety
Study Committee

## PROPOSED AMENDMENT TO ZONING CODE
## REPLACEMENT OF EARTHQUAKE HAZARDOUS BUILDINGS

Sec. 12.23-A,7 Replacement Earthquake Hazardous Buildings- Notwithstanding any other provision of this article to the contrary, a building non-conforming as to use, height-floor area ratio, yards, and/or parking may be constructed to replace the same non-conforming use, height-floor area ratio, yards and/or parking in a legal non-conforming building which has been demolished as a result of enforcement of the Earthquake Safety Ordinance (Division 68 of the Building Code), provided that construction is started within one year of demolition and completed within two years of commencement, and that the use of said replacement building is not changed from that of the original. Otherwise, any reconstruction must conform in every respect with the current zoning regulations. The replacement of buildings permitted by this provision shall not apply to an existing commercial or industrial use on property located in a residential zone, unless the residentially zoned property is designated in a commercial or industrial land use category on an adopted Community Plan element of the General Plan.

"EXHIBIT "B"

December, 1978

## REPORT OF
## IMPACT EVALUATION SUBCOMMITTEE
## OF THE EARTHQUAKE SAFETY STUDY COMMITTEE

The initial organizational meeting of the Earthquake Safety Study Committee took place on March 23, 1977. At that time, members of the Committee were appointed to either the Technical Subcommittee or to the Impact Evaluation Subcommittee or, in some instances, to both. Following the initial meeting of March 23, 1977 of the entire Committee, the Impact Evaluation Subcommittee met on April 6, 1977 and May 11, June 23, August 11, September 20, October 27, November 2, and December 14, 1977 and on March 8, March 29, May 23, June 20, and August 22, 1978.

The initial members of the Committee were Douglas Dearden, Chairman, Richard DeLuce, Secretary, and Moe Greendale, Rev. Luther Holland, Al Atchison, Earl Schwartz, William Heeb, Richard Wirth, Danny Montoya, and Robert Wilhelm.

After its initial two meetings, the Impact Subcommittee chairman and other members of the Subcommittee were concerned that the Subcommittee needed additional expertise. As a result, the Subcommittee Chairman sought and obtained approval from Mr. Williams, Chairman of the Special Earthquake Study Committee, to add additional members to the Impact

EXHIBIT "C"

best copy available

Evaluation Committee. This was done during May and June of 1977. These additional members include Larry Scherzer of Arthur Young & Company, Jay Lloyd of Marsh & McLennan, David Reed of California Savings and Loan, Joe Vaccaro of Leo A. Daly Co., and Mike Saltzman of the City Housing Agency.

The Subcommittee has reviewed the drafts of the ordinance submitted to it by the Technical Subcommittee and has offered a number of suggestions which have been incorporated.

However, the suggestions have been addressed to matters of procedure and to definitions. The proposed ordinance does not purport to deal with any social or economic aspects.

The main purpose of the Impact Evaluation Subcommittee was to study the economic, financial and social impacts on the City of adopting an earthquake safety ordinance.

The Subcommittee has identified a number of areas of concern. The Impact Evaluation Subcommittee believes that these areas of concern must be given full consideration by the City Council when it reviews and considers the adoption of the proposed ordinance. The areas of concern are as follows:

1. Cost of Repair. At this time, no one has any firm figures on what the cost of repair and rehabilitation to meet the requirements of the proposed ordinance will be.

The cost of strengthening under the current proposal may well be less than the amount of $16 per square foot projected for the 1977 proposal. Preliminary estimates, which vary widely, usually have been somewhere between five to ten dollars per square foot. They probably vary somewhat from building to building.

Some tests have been conducted under the auspcies of the City's Building and Safety Department to determine a feasible and economic method of testing the buildings covered by the proposed ordinance. The new type of tests, in the opinion of the Department, should result generally in somewhat lower costs of repair. But such tests do not give any accurate information as to the costs of repair.

The Subcommittee believes that without reasonably accurate information as to the cost of rehabilitation required by the proposed ordinace that it is not possible to determine the impact of the proposed ordinance.

2. Availability of Financing. Closely related to the cost of repair is the subject of financing such rehabilitation. No one knows whether any financing will be available. The best information available to the Subcommittee is that financing from conventional sources such as savings and loans, commercial banks and insurance companies may be difficult, if not impossible, to obtain.

At the present time the only federal funds available are only allocable to residential buildings. There appears to be none available for commercial structures.

One suggestion made to the Mayor's Office was to attempt to assemble a pool of funds from the local financial community, such as savings and loans, banks and insurance companies. Thus far such attempts have not been fruitful.

Without financing it would appear affected building owners in many cases will have no choice but to let their buildings be demolished pursuant to the proposed ordinance.

The Subcommittee believes that until there is reasonable assurance that financing will be available, the City Council should defer enactment of the proposed ordinance.

3. Liability Insurance. Another major area of concern is the question of liability insurance for the building owners. Once an ordinance is adopted, the best information obtainable by this Subcommittee is that underwriters may use the ordinance as a basis to either obtain very substantial premium cost increases or perhaps even refuse to write the insurance. Undue increases in liability insurance have not occurred in Long Beach which has had a similar ordinance for several years. However, there are only about 800 buildings involved in Long Beach. In addition, there has been little publicity about it. Publicity seems to be an important factor in affecting underwriters and thus rates.

4. Relocation of Residents. The Subcommittee has not been able to come up with any definitive information as to whether any funds are available for relocation of residents resulting from displacement by either repair or demolition. None appear available for tenants of commercial buildings. The proposed ordiance does not cover buildings with four or less units and thus it will affect fewer residential buildings than the 1977 proposal. The reason for exempting residential buildings with four or less units was based on the classification followed by lending institutions.

5. Effect on Residential Tenants. Assuming that owners of residential buildings are able to obtain funds with which to repair their buildings to meet the terms of the proposed ordinance, it is obvious that rentals will be increased in order to offset such costs of repair. The Subcommittee has not been able to quantify with any precision what the norm of such increases would be. Nevertheless, there is no doubt that some increase in rentals would occur. The Subcommittee also has not been able to determine the impact upon the tenants. Certainly some significant number of tenants of these buildings are senior citizens and some significant number are from lower economic groups.

6. Effect on City Taxes. The Subcommittee attempted to obtain some information about the possible impact on the

City's tax revenue. Once the Building and Safety Department's survey of pre-1933 buildings is completed, we understand that it will be possible to obtain a partial listing of assessed valuations for the affected buildings, but the Department does not have access to the amount of real property taxes. However, that probably can be estimated from the valuation figures. In addition, the effect on City property tax revenue will be less than formerly contemplated because of the passage of Proposition 13 which already has reduced substantially revenue from property taxes. Questions which are harder to analyze are the economic impact of businesses located in pre-1933 buildings moving out of the City entirely when faced with either having their tenancy interrupted or facing the cost of repair and rehabilitation of a pre-1933 building.

In connection with the problem of funding repair and rehabilitation of the affected buildings, the Subcommittee has identified a number of areas that need further exploration but all entail legislative action at either the state or federal level. These include such suggestions as tax incentives for owners who engage in rehabilitation work, perhaps along the line of incentives which have been granted for installation of home insulation and solar heating. Another possibility is low interest loans for rehabilitation work on an analogy that such work is similar to flood prevention work.

If the proposed ordinance is to be adopted, the Subcommittee recommends the adoption of a companion ordinance. It will permit the construction of a new building, resulting from demolition of a present structure due to the Earthquake Safety Ordinance, without the necessity of meeting present zoning requirements for parking and setbacks. The Subcommittee has concluded that this would provide incentives to owners and developers to provide new structures (which must meet higher building standards) which would be of greater benefit to the community than rehabilitation of present buildings.

In conclusion, as the Subcommittee has tried to deal with these problems since April of 1977, it has become apparent that the Subcommittee itself is not equipped to take on the task of preparing an environmental impact report, nor apparently was it ever contemplated that the Subcommittee itself would engage in the preparation of an environmental impact report. The Subcommittee has identified the social, economic and financial areas which it believes will be affected and has offered some suggestions which may be worth further exploration and development by the City.

The Impact Evaluation Subcommittee wishes to emphasize that these social, economic and financial impacts appear to be very real and should be given close consideration by the City Council in connection with the possible adoption of the proposed earthquake safety ordinance.

Respectfully submitted,
Impact Evaluation Subcommittee

By
Douglas Dearden - Chairman

Richard D. DeLuce
Richard DeLuce - Secretary

PRELIMINARY DRAFT
AS APPROVED BY THE EARTHQUAKE SAFETY STUDY COMMITTEE
NOVEMBER 9, 1978

## DIVISION 68 - EARTHQUAKE HAZARD REDUCTION IN EXISTING BUILDINGS

### SEC. 91.6801. PURPOSE

The purpose of this Division is to promote public safety and welfare by reducing the risk of death or injury that may result from the effects of earthquakes on unreinforced masonry bearing wall buildings constructed before 1934. Such buildings have been widely recognized for their sustaining of life hazardous damage as a result of partial or complete collapse during past moderate to strong earthquakes.

The provisions of this Division are minimum standards for structural seismic resistance established primarily to reduce the risk of life loss or injury and will not necessarily prevent loss of life or injury or prevent earthquake damage to an existing building which complies with these standards. This Division shall not require existing electrical, plumbing, mechanical or fire safety systems to be altered unless they constitute a hazard to life or property.

This Division provides systematic procedures and standards for identification and classification of unreinforced masonry bearing wall buildings based on their present use. Priorities and standards are also established under which these buildings are required to be structurally analyzed. Where the analysis or testing determines deficiencies, this Division requires the building to be strengthened or demolished.

### SEC. 91.6802. SCOPE

The provisions of this Division shall apply to all existing buildings constructed or under construction prior to October 6, 1933, which on the effective date of this ordinance have unreinforced masonry bearing walls as defined herein.

EXCEPTION: This Division shall not apply to detached dwellings and detached apartment houses containing less than 5-dwelling units.

### SEC. 91.6803. DEFINITIONS

For the purpose of this Division, certain terms are defined in Sections 91.2301, 91.2305 and as follows:

ESSENTIAL BUILDINGS: Those structures or buildings which are to be used for emergency purposes after an earthquake in order to preserve the peace, health and safety of the general public.

EXHIBIT "A"

Such facilities shall include the following: hospitals and other medical facilities having surgery or emergency treatment areas; fire and police stations; municipal government disaster operation centers; and public utility and communication buildings deemed to be vital in emergencies.

HIGH RISK BUILDINGS: Any building, other than an essential building, having an occupant load as determined by Section 91.3301(d) of 100 occupants or more, wherein the occupancy is used for its intended purpose for more than 20 hours per week.

EXCEPTION: High risk buildings shall not include buildings having exterior walls braced with masonry cross walls or wood frame cross walls spaced less than 40 feet apart in each story.

LOW RISK BUILDINGS: Any building, other than an essential building, having an occupant load as determined by Section 91.3301(d) of less than 20 occupants.

MEDIUM RISK BUILDINGS: Any building having an occupant load as determined by Section 91.3301(d) of 20 occupants or more that is not classified as a high risk building or an essential building.

UNREINFORCED MASONRY BEARING WALL: A masonry wall having all of the following characteristics:

1. Provides the vertical support for a floor or roof.
2. The total superimposed load is over 100 pounds per linear foot.
3. The area of reinforcing steel is less than 50% of that required by Section 91.2418(c) of this code.

## SEC. 91.6804. RATING CLASSIFICATIONS

(a) CLASSIFICATION. The rating classifications as exhibited in Table No. 68-A are hereby established and each building within the scope of this Division shall be placed in one such rating classification by the Department. The total occupant load as determined by Section 91.3301(d) of the entire building shall be used to determine the rating classification.

TABLE NO. 68-A
RATING CLASSIFICATIONS

| TYPE OF BUILDING | CLASSIFICATION |
|---|---|
| Essential Buildings | I |
| High Risk Buildings | II |
| Medium Risk Buildings | III |
| Low Risk Buildings | IV |

(b) MULTIPLE CLASSIFICATIONS. For the purpose of determining a Rating Classification, a building housing occupancies resulting in more than one rating classification shall be classified in the Rating Classification which is the most restrictive.

EXCEPTION: For the purpose of this Division, portions of buildings constructed to act independently when resisting seismic forces may be classed in separate rating classifications.

## SEC. 91.6805. ADMINISTRATION

(a) PRIORITY OF NOTIFICATION. Notification priorities for buildings within the scope of this Division shall be in accordance with the rating classifications determined for the buildings from Table No. 68-A. Buildings having a rating classification of I shall be notified first; buildings having a rating classification of II shall be notified second, but not earlier than 6 months after the effective date of this Division; buildings having a rating classification of III shall be notified third, but not earlier than 18 months after the effective date of this Division; and buildings having a rating classification of IV shall be notified last, but not earlier than five years after the effective date of this Division. Within each separate Rating Classification, the notification shall normally be based on the occupant load of the building, with the buildings housing larger occupant loads being notified first. The Department shall, upon receipt of a written request from the owner, order a building to comply with this Division prior to the normal notification date set forth in this Section.

(b) NOTIFICATION. Following the priorities listed in Subsection 91.6805(a), the Department shall order the owner of each building within the scope of this Division to cause a structural analysis to be made of the building by a licensed civil or structural engineer or architect. If the building is found to be deficient in meeting the requirements of this Division, the owner shall cause it to be structurally altered so as to conform to such requirements or be demolished.

The order shall be in writing and shall be served either personally or by certified or registered mail upon the owner as shown in the last equalized assessment roll, and upon the person, if any, in apparent charge or control of the building.

The order shall direct that the structural analysis and the structural strengthening plans, if required, be submitted to the Department for review within 270 days after service of the order. If the owner elects to demolish the building, a statement declaring an intention to demolish shall be submitted to the Department within 270 days after service of the order.

The order shall specify that permits required to demolish the building or accomplish the necessary structural alterations shall be obtained no later than one year after the service of the order, the necessary alterations or demolition must commence within 180 days of the date that the permit was issued and that the building be corrected to meet the minimum requirements of this Division or be demolished no later than three years after such service.

(c) APPEAL FROM ORDER. Within 180 days of the service of the order described in Subsection 91.6805(b) the owner or person if any, in apparent charge or control of the building may appeal the Department's initial order and determination to the Board of Building and Safety Commissioners in accordance with procedures established in Section 98.0403 of the Los Angeles Municipal Code. Any such appeal shall be decided by the Board no later than 60 days after the date that the appeal is filed.

(d) RECORDATION. At the time that the Department serves the aforementioned order, the Superintendent of Building shall file with the Office of the County Recorder a certificate stating that the subject building is within the scope of Division 68 - Earthquake Hazard Reduction in Existing Buildings - of the Los Angeles Municipal Code. The certificate shall also state that the owner thereof has been notified and has been ordered to structurally analyze the building and to structurally strengthen or demolish it where compliance within Division 68 is not exhibited.

If the building is either demolished, found not to be within the scope of this Division, or is structurally capable of resisting minimum seismic forces required by this Division as a result of structural alterations or an anlysis, the Superintendent of Building shall file with the Office of the County Recorder a certificate terminating the status of the subject building as being classified within the scope of Division 68 - Earthquake Hazard Reduction in Existing Buildings in the Los Angeles Municipal Code.

(e) ENFORCEMENT. If the owner or other person in charge and control of the subject building fails to comply with the order within any of the time periods set forth in Section 91.6805(b) the Superintendent of Building shall order that the entire building be vacated and that the building remain vacated until all required analysis and structural alterations have been completed. Whenever compliance with the aforementioned order issued pursuant to the provisions of this Division has not been accomplished within 90 days after the date the building has been ordered vacated, or such additional time as may have been granted by the Board, the Superintendent may order its demolition in accordance with the provisions of Section 91.0103(o).

## SEC. 91.6806. ANALYSIS AND DESIGN

(a) GENERAL. Every structure within the scope of this Division shall be analyzed and constructed to resist minimum total lateral seismic forces assumed to act nonconcurrently in the direction of each of the main axes of the structure in accordance with the following equation:

$$V = IKCSW \qquad (68\text{-}1)$$

The value of IKCS need not exceed the values set forth in Table No. 68-B based on the applicable rating classification of the building.

### TABLE NO. 68-B
### HORIZONTAL FORCE FACTORS BASED ON RATING CLASSIFICATION

| RATING CLASSIFICATION | IKCS |
|---|---|
| I | 0.186 |
| II | 0.133 |
| III & IV | 0.100 |

(b) LATERAL FORCES ON ELEMENTS OF STRUCTURES. Parts or portions of structures shall be analyzed and designed for lateral loads in accordance with Section 91.2305(d) but need not be more than the value from the following equation:

$$F_p = IC_pSW_p \qquad (68\text{-}2)$$

For the provisions of this subsection, the product of IS need not exceed the values as set forth in Table No. 68-C.

EXCEPTION: Unreinforced masonry walls in buildings not having a rating classification of I may be analyzed in accordance with Section 91.6807.

### TABLE NO. 68-C
### HORIZONTAL FORCE FACTORS "IS"
### FOR PARTS OR PORTIONS OF STRUCTURES

| RATING CLASSIFICATION | IS |
|---|---|
| I | 1.50 |
| II | 1.00 |
| III & IV | 0.75 |

(c) ANCHORAGE AND INTERCONNECTION. Anchorage and interconnection of all parts, portions and elements of the structure shall be analyzed and designed for lateral forces in accordance with Table No. 23-B and the equation $F_p = IC_pSW_p$ as modified by Table No. 68-C. Minimum anchorage of masonry walls to each floor or roof shall resist a minimum force of 200 pounds per lineal foot acting normal to the wall at the level of the floor or roof.

(d) LEVEL OF REQUIRED REPAIR. Alterations and repairs required to meet the provisions of this Division shall comply with all other applicable requirements of this Code unless specifically provided for in this Division.

(e) REQUIRED ANALYSIS.

1. GENERAL. Except as modified herein, the analysis and design relating to the structural alteration of existing structures within the scope of this Division shall be in accordance with the analysis specified in Division 23.

2. CONTINUOUS STRESS PATH. A complete, continuous stress path from every part or portion of the strucutre to the ground shall be provided for the required horizontal forces.

3. POSITIVE CONNECTIONS. All parts, portions or elements of the strucutre shall be interconnected by positive means.

(f) ANALYSIS PROCEDURE.

1. GENERAL. Stresses in materials and existing construction utilized to transfer seismic forces from the ground to parts or portions of the structure shall conform to those permitted by the Code and those materials and types of construction specified in Section 91.6807.

2. CONNECTIONS. Materials and connectors used for interconnection of parts and portions of the structure shall conform to the Code.

3. UNPEINFORCED MASONRY WALLS. Unreinforced masonry walls shall be analyzed to insure their capability of resisting superimposed vertical loads in eddition to the seismic forces required by this Division. The 50 percent increase in the seismic force factor for shear walls as specified in Table No. 24-H may be omitted in the computation of seismic loads to existing shear walls.

Allowable stresses in such walls shall be obtained by tests utilizing values established by laboratory testing as specified in Section 91.6807(e), however, no allowable tension stress will be permitted. Walls not capable of resisting the applied loads shall be strengthened to resist the forces specified in this Division or shall be removed and replaced.

EXCEPTION:

1. Unreinforced masonry walls in buildings not classified as a Classification Rating I may be analyzed in accordance with Section 91.6807.

2. Unreinforced masonry walls which carry no design loads other than its own weight may be considered as veneer if they are adequately anchored to new supporting elements.

(g) COMBINATION OF LOAD EFFECTS.

1. NEW MATERIALS. Combination of load effects shall conform to the Code for all new materials introduced into the building structure to meet the requirements of this Section.

2. EXISTING MATERIALS. When stress in existing lateral force resisting elements are due to a combination of dead loads plus live loads plus seismic loads, the allowable working stress specified in the Code may be increased 100%. However, no increase will be permitted in the stresses allowed in Section 91.6807 of this Division and the stresses in members due only to seismic and dead loads shall not exceed the values permitted by Section 91.2301(g).

3. ALLOWABLE REDUCTION OF BENDING STRESS BY VERTICAL LOAD. In calculating tensile fiber stress due to seismic forces required by this Division, the maximum tensile fiber stress may be reduced by the full direct stress due to vertical dead loads.

## SEC. 91.6807. MATERIALS OF CONSTRUCTION

(a) GENERAL. All materials permitted by this Code including their appropriate allowable stresses and those existing configurations of materials specified herein may be utilized to meet the requirements of this Division.

(b) EXISTING MATERIALS.

1. UNREINFORCED MASONRY WALLS. Unreinforced masonry walls analyzed in accordance with this Section may provide vertical support for roof and floor construction and resistance to lateral loads. The bonding of such walls shall be as specified in Section 91.2412(b).

Tension stresses due to seismic forces normal to the wall may be neglected if the walls does not exceed the height or length to thickness ratio and the in-plane shear stresses due to seismic loads as set forth in Table No. 68-D.

TABLE NO. 68-D
ALLOWABLE VALUE OF
UNREINFORCED MASONRY WALLS (1)
WITH MINIMUM QUALITY MORTAR

| RATING CLASSIFICATION | MAXIMUM RATIO UNSUPPORTED HEIGHT OR LENGTH TO THICKNESS | SEISMIC IN-PLANE SHEAR STRESS BASED ON GROSS AREA |
|---|---|---|
| I | Not applicable (2) | Not Applicable (2) |
| II | 9 | 3 psi (3) |
| III | 10 | 3 psi (3) |
| IV | 12 | 3 psi (3) |

NOTES: (1) Minimum quality mortar shall be determined by laboratory testing in accordance with Section 91.6807(e).

(2) Walls of buildings within rating classification I shall be analyzed in accordance with Section 91.6806(f).

(3) Allowable shear stress may be increased in accordance with Section 91.6807(g).

The wall height or length may be measured horizontally to supporting elements providing the stiffness of the supporting member is at least twice as stiff as the tributary wall. Stiffness shall be based on the gross section.

2. EXISTING ROOF, FLOORS, WALLS, FOOTINGS, AND WOOD FRAMING. Existing materials including wood shear walls utilized in the described configuration may be used as part of the lateral load resisting system, provided that the stresses in these materials do not exceed the values shown in Table No. 68-E.

TABLE NO. 68-E

VALUES FOR EXISTING MATERIALS

| | MATERIALS(1) | ALLOWABLE VALUES |
|---|---|---|
| 1. | HORIZONTAL DIAPHRAGMS | |
| | a. Roofs with straight sheathing and roofing applied directly to the sheathing. | 150 lbs. per foot for seismic shear. |
| | b. Roofs with diagonal sheathing and roofing applied directly to the sheathing. | 400 lbs. per foot for seismic shear. |
| | c. Floors with straight tongue and groove sheathing. | 150 lbs. per foot for seismic shear. |
| | d. Floors with straight sheathing and finished wood flooring. | 300 lbs. per foot for seismic shear. |
| | e. Floors with diagonal sheathing and finished wood flooring. | 400 lbs. per foot for seismic shear. |
| | f. Floors or roofs with straight sheathing and plaster applied to the joist or rafters.(2) | Add 50 lbs. per foot to materials 1a and 1c. |
| 2. | SHEAR WALLS | |
| | a. Wood stud walls with wood lath and plaster. | 50 lbs. per foot each side for seismic shear. |
| | b. Wood stud walls with plaster and lath other than wood lath. | 100 lbs. per foot each side for seismic shear. |
| 3. | PLAIN CONCRETE FOOTINGS. | $f'_c = 1500$ psi unless otherwise shown by tests. |

| | |
|---|---|
| 4. DOUGLAS FIR WOOD | **Allowable stress same as No. 1 D.F.** |
| 5. REINFORCING STEEL | **$f_t$ = 20,000 lbs. per square inch maximum.** |
| 6. STRUCTURAL STEEL | **$f_t$ = 20,000 lbs. per square inch maximum.** |

NOTES: (1)Material must be sound and in good condition.

(2)The wood lath and plaster must be reattached to existing joists or rafters in a manner approved by the Department.

### (c) STRENGTHENING OF EXISTING MATERIALS.

**New materials including wood shear walls may be utilized to strengthen portions of the existing seismic resisting system in the described configurations provided that the stresses do not exceed the values shown in Table No. 68-F.**

### TABLE NO. 68-F
### ALLOWABLE VALUES OF NEW MATERIALS USED IN CONJUNCTION WITH EXISTING CONSTRUCTION

| NEW MATERIALS | ALLOWABLE VALUES |
|---|---|
| 1. HORIZONTAL DIAPHRAGMS | |
| Plywood sheathing applied directly over existing straight sheathing with ends of plywood sheets bearing on joists or rafters and edges of plywood located on center of individual sheathing boards. | Same as specified in Table 25-J for blocked diaphragms. |
| 2. **SHEAR WALLS** | |
| **a. Plywood sheathing applied directly over existing wood studs. No value shall be given to plywood applied over existing plaster or wood sheathing.** | **Same as values specified in Table 25-J for shear walls.** |
| b. Dry wall or plaster applied directly over existing wood studs. | 75 per cent of the values specified in Table 25-N. |
| **c. Dry wall or plaster applied to plywood sheathing over existing wood studs.** | **33 1/3 per cent of the values specified in Table 25-N.** |
| **3. Shear bolts and shear dowels embedded a minimum of 8 inches** | **100 percent of the values for plain masonry specified** |

| | | |
|---|---|---|
| | into unreinforced masonry walls. Bolt centered in a 2 ½ inch diameter hole with dry-pack or non-shrink grout around circumference of bolt or dowel.(1) | in Table 24F. No values larger than those given for 3/4 inch bolts shall be used. |
| 4. | Tension bolts and tension dowels extending entirely through unreinforced masonry walls secured with bearing plates on far side of wall with at least 30 sq. inches of area.(2) | 1200 lbs. per bolt or dowel. |
| 5. | Reinforced masonry infilled openings in existing unreinforced masonry walls with dowels to match reinforcing. | Same as values specified for unreinforced masonry walls. |
| 6. | Masonry piers and walls reinforced per Section 91.2418 and designed for tributary loads. | Same as values specified in Table 24-G. |
| 7. | Concrete footings, walls and piers reinforced as specified in Division 26 and designed for tributary loads. | Same as values specified in Division 26. |
| 8. | Foundation pressures for structures exhibiting no evidence of settlement. | Calculated existing foundation pressures due to maximum dead load plus live load may be increased 25% for dead load, and may be increased 50% for dead load plus seismic load required by this Division. |

NOTES: (1)Bolts and dowels to be tested as specified in Section 91.6807(f).

(2)Bolts and dowels to be ½ inch minimum in diameter.

(d) ALTERNATE MATERIALS. Alternate materials and methods of construction may be approved by the Department in accordance with the provisions of Article 8, Chapter 9 of the Los Angeles Municipal Code.

(e) MINIMUM ACCEPTABLE QUALITY OF EXISTING UNREINFORCED MASONRY WALLS.

1. GENERAL PROVISIONS. All unreinforced masonry walls utilized to carry vertical loads and seismic forces parallel and perpendicular to the wall plans shall be tested as specified in this Section. All masonry quality shall equal or exceed the

minimum standards established herein or shall be removed and replaced by new materials. Alternate methods of testing may be approved by the Department. Nothing shall prevent pointing with cement mortar of all the masonry wall joints before the tests are first made. If the exterior joints are pointed then the inside face must also be pointed. Prior to any pointing, the wall surface must be sand or water blasted to remove loose and deteriorated mortar. All preparation and cement mortar pointing shall be done under the continuous inspection of a registered deputy inspector with a subsequent written report to the Department. All testing shall be performed by an approved testing agency in accordance with the requirements specified in this Subsection.

EXCEPTION: Unreinforced masonry walls which carry no design loads other than its own weight may be considered as veneer if they are adequately anchored to new supporting elements.

2. NUMBER AND LOCATION OF TESTS. The quality of mortar in all masonry walls shall be determined by performing in place shear tests or by testing eight inch diameter cores. The minimum number of tests shall be two per wall or line of wall elements resisting a common force, or 1 per 1500 square foot of wall surface, with a minimum of eight tests in any case. The exact test or core location shall be determined at the building site by the licensed engineer or architect responsible for the seismic analysis of the subject building. The results of all tests or coring shall be recorded and reported.

3. IN-PLACE SHEAR TESTS. The bed joints of the outer wythe of the masonry shall be tested in shear by laterally displacing a single brick relative to the adjacent bricks in that wythe. The opposite head joint of the brick to be tested shall be removed and cleaned prior to testing. The minimum quality mortar in 80 percent of the shear tests shall not be less than the total of 30 psi plus the axial stress in the wall at the point of the test. The shear stress shall be based on the gross area of both bed joints and shall be that at which movement of the brick is first observed.

4. CORE TESTS. A minimum number of mortar test specimens equal to the number of required mores shall be prepared from the cores and tested as specified herein. The mortar joint of the outer wythe of the masonry core shall be tested in shear by placing the circular core section in a compression testing machine with the mortar bed joint rotated 15 degrees from the axis of the applied load. The mortar joint tested in shear shall have an average ultimate stress based on the gross area of 20 psi. The average shall be made from the total number of cores made. If test specimens cannot be made from cores taken the shear value shall be reported as zero. The results of all coring and shear testing shall be reported.

(f) TESTING OF SHEAR BOLTS. One-fourth of all new shear bolts and dowels embedded in unreinforced masonry walls shall be tested by a registered deputy inspector using a torque calibrated wrench to the following minimum torques:

1/2" diameter bolts or dowels = 40 foot-lbs.
5/8" diameter bolts or dowels = 50 foot-lbs.
3/4" diameter bolts or dowels = 60 foot-lbs.

No bolts exceeding 3/4" shall be used. All nuts shall be installed over malleable iron or plate washers when bearing on wood and heavy cut washers when bearing on steel.

(g) DETERMINATION OF ALLOWABLE STRESSES FOR DESIGN METHODS BASED ON TEST RESULTS.

1. DESIGN SHEAR VALUES. Design seismic in-plane shear stresses greater than permitted in Table No. 68-D shall be substantiated by tests performed as specified in Section 91.6807(e) 3 and 4.

Design stresses shall be related to test results obtained as noted in Table No. 68-G. Intermediate values between 3 and 5 psi may be interpolated.

TABLE NO. 68-G
ALLOWABLE SHEAR STRESS FOR TESTED
UNREINFORCED MASONRY WALLS

| Eighty percent of test results in psi not less than | Average test results of cores in psi | Seismic in-plane shear based on gross area |
|---|---|---|
| 30 plus axial stress | 20 | 3 psi(1) |
| 40 plus axial stress | 27 | 4 psi(1) |
| 50 plus axial stress or more | 33 or more | 5 psi(1) |

(1) Allowable shear stress may be increased by addition of 10% of the axial stress due to the weight of the wall directly above.

2. DESIGN COMPRESSION AND TENSION VALUES. Compression stresses for unreinforced masonry having a minimum design shear value of 3 psi shall not exceed 100 psi. Design tension values for unreinforced masonry shall not be permitted.

## SEC. 91.6808. INFORMATION REQUIRED ON PLANS

(a) GENERAL. In addition to the seismic analysis required elsewhere in this Division, the license engineer or architect responsible for the seismic analysis of the subject building shall determine and record the information required by this Section on the approved plans.

(b) CONSTRUCTION DETAILS. The following construction details shall be made part of the approved plans:

1. All unreinforced masonry walls shall be anchored to all floors and roofs with tension bolts through the wall or by existing rod anchors at a maximum anchor spacing of six feet. All existing

rod anchors shall be secured to joists or rafters by bolting to develop the required forces. The Department may require testing to verify adequacy of embedded ends of existing rod anchors.

2. Diaphragm chord stresses of horizontal diaphragms shall be developed in existing materials or by addition of new materials.

3. Where wood roof or floor members other than rafters or joists are supported in masonry pockets, ledgers or columns shall be installed to support vertical loads of the roof or floor members.

4. Parapets and exterior wall appendages not capable of resisting the forces specified in this Division shall be removed, stabilized or braced to insure that the parapets and appendages remain in their original position.

5. All deteriorated mortar joints in unreinforced masonry walls shall be pointed with cement mortar. Prior to any pointing, the wall surface must be sand or water blasted to remove loose and deteriorated mortar. All preparation and pointing shall be done under the continuous inspection of a registered deputy masonry or concrete inspector with a subsequent written report to the Department.

6. Repair details of any cracked or damaged unreinforced masonry wall required to resist forces specified in this Division.

(c) EXISTING CONSTRUCTION. The following existing construction information shall be made part of the approved plans:

1. The approximate age of building.
2. The typical footing width, depth and maximum soil bearing for dead plus live loads.
3. The type and dimensions of existing walls and the size and spacing of floor and roof members.
4. The extent and type of existing wall anchorage to floors and roof.
5. The extent and type of parapet corrections which were performed in accordance with Section 91.0103(b)
6. Accurately dimensioned floor plans and masonry wall elevations showing dimensioned openings, piers, wall thickness and heights.
7. The location of cracks or damaged portions of unreinforced masonry walls requiring repairs.
8. The type of interior wall surfaces and if reinstalling or anchoring of ceiling plaster is necessary.
9. The general condition of the mortar joints and if the joints need pointing.

CITY OF LOS ANGELES
OFFICE OF THE CHIEF LEGISLATIVE ANALYST
CITY COUNCIL

KEN SPIKER
CHIEF LEGISLATIVE ANALYST

September 24, 1979

Honorable Members of the
  Building and Safety Committee

Re: CF 74-4395, CF 73-721
    Proposed Ordinance - Earthquake Hazardous Buildings

Honorable Members:

Pursuant to the request of your Committee, this office has updated our previous report of February 5, 1979 to the former Chairperson of the Committee regarding potential sources of financing to rehabilitate buildings affected by the proposed earthquake ordinance, requiring all pre-1933 unreinforced masonry wall bearing buildings to be brought up to code.

The Building and Safety Department estimates that a total of 7,876 buildings will be affected in all Council districts. This figure does not include dwellings or apartment buildings of fewer than five units as these are not covered in the proposed ordinance. Of the total buildings affected, 6,769 are commercial, industrial, or hotel buildings; 811 are apartment houses; 134 are public buildings, hospitals or nursing homes; and 162 are miscellaneous.

Costs of the strengthening program are estimated to be between $500 million to $1 billion spread over a ten year period. This could represent an expenditure of approximately $50 to $100 million per year for this rehabilitation program. Although this is a very large figure it is not unmanageable considering that the 1978 building permit volume of construction processed by the City of Los Angeles totaled almost $1.5 billion.

This report includes a variety of financing mechanisms to assist owners in rehabilitating their properties as well as potential financing to provide housing for tenants displaced because of rehabilitation activities. In listing the possibilities, they are compiled under Federal, State, and Local sources.

Attachment A provides a list of steps that the Committee may wish to consider relative to coordinating and pursuing the most viable financing possibilities.

Respectfully submitted,

Ken Spiker
Ken Spiker
Chief Legislative Analyst

KS:EB/jc

ROOM 255, CITY HALL    90012 - 485-3327

- Discuss with the National Neighborhood Investment Corporation their continuation in the City, or expansion of activities to coordinate program of meeting code requirements relative to the earthquake ordinance for affected apartment owners; as an alternative to using Housing Advisory Service and/or Municipal Finance Agency, for this purpose;

- Recommendations for amending the City's rent control ordinance to provide a different formula upon which rents could be increased for low and moderate income tenants in connection with rehabilitation mandated by the proposed earthquake ordinance;

- Recommendations relative to how much money could be directed each year from the Community Redevelopment Agency Bunker Hill tax increment financing for purposes of providing displacement housing;

- All other matters, as deemed appropriate, relative to taking advantage of existing programs with HUD and discussion with local financial institutions their possible future cooperation and involvement.

- Recommendations relative to City sponsorship of State legislation to permit a number of years during which there would be no re-evaluation of property on which seismic improvements had been made pursuant to the ordinance;

- Recommendations relative to City sponsorship of amendments to the State Relocation Act to provide financial assistance to individuals or small businesses required to relocate because of this or a similar hazards abatement program.

- Recommendations relative to a City support position on ACA 55, presently in the Assembly Housing and Community Development, not set for hearing. ACA 55 would authorize the Legislature to impose a property tax surcharge upon commercial and industrial property. The amount of surcharge would be 10% of the annual property tax liability, excluding debt service levies.

  The proceeds from such surcharge would be used to provide financial incentives to public and private entities for construction or rehabilitation of residential real property and to facilitate public participation in the planning of local housing production.

  The City's Intergovernmental Relations Committee will be considering a possible City position on this item in the near future.

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ATTACHMENT B

## ACTION STEPS TO MAXIMIZE ASSISTANCE

Following are suggested action steps that could be taken at this time to expedite the City's role in providing assistance, both technical and financial, to those people who will be affected by the proposed earthquake ordinance.

-- Direct the Building and Safety Department to meet with representatives of the involved City departments and other appropriate entities and report within one month's time on the coordinated approach that should be taken by the City to most effectively provide assistance. Their considerations should include:

  - Status of the Municipal Finance Agency: possible date of implementation; feasibility of expanding concept to provide additional funding for earthquake financing program; feasibility of that Agency's administering technical and financial assistance to those requiring it pursuant to the earthquake ordinance;

  - Status of the Ullman Bill and its possible impact both on the issuance of tax exempt bonds and borrowing from local financial institutions with HCD funds as leveraging mechanism;

  - Feasibility of establishing a Housing Advisory Service (HAS) which could provide coordination and informational service relative to the various funding alternatives, with funding by the State Housing and Community Development Department (This approach would be an alternative to the Municipal Finance Agency or as an interim measure, should the MFA be the logical administering agency but the time frame for using the MFA in this effort would be prohibitive).

  - Recommendations for amending the CARE, HELP, and/or MORE programs to make them more appropriate to the needs of those affected by the ordinance. In this regard, consideration should include:

    - additional funding that could be allocated in the next HCD Program Year or reprogrammed for this effort;

    - expansion of eligibility criteria;

    - extension of loan repayment period;

    - increase of loan level; and in the case of the HELP program, possible inclusion of loans that include an interest charge, lower than the market rate, for this particular program;

ATTACHMENT B

# FUNDING SOURCES AVAILABLE TO ASSIST IN
# REHABILITATION
# RELEVANT TO THE EARTHQUAKE ORDINANCE

Office of Chief Legislative Analyst
September 24, 1979

## FUNDING SOURCES AVAILABLE TO ASSIST IN REHABILITATION RELEVANT TO THE EARTHQUAKE ORDINANCE

### FEDERAL

1). U. S. Department of Housing and Urban Development (HUD)

A. Housing and Community Development Block Grant (HCDBG)

Eligible activities under this program include the clearance, demolition, removal, strengthening, and rehabilitation of buildings and improvements. This includes financing rehabilitation of privately owned properties through the use of direct grants, loans, loan guarantees or interest supplements when provided in connection with other physical development activities described in the City's community development program.

An important consideration of the City's HCDBG monies, however, is that a maximum of 25% of the City's Block Grant funds may be used in areas outside of a designated "low and moderate income" area for the purpose of eliminating blight. Otherwise the HCDBG monies must be restricted to usage in low and moderate income areas. Most of the affected pre-1933 buildings are concentrated in the downtown, Hollywood, Wilshire, and Westlake areas, and some of these areas correspond to the 24 "neighborhood strategy areas" as defined for HCDBG purposes.

Although existing federal legislation has authorized the HCD program only through FY1980, it is expected that the HCD Block Grant program will be continued, with an entitlement of approximately $50 million per year for the City of Los Angeles.

There are severe limitations on the use of HCD Block Grant funds for rehabilitation of public buildings, unless it would be to provide access for the handicapped.

1. Commercial Area Revitalization Effort (CARE)

The City's HCDBG funded CARE program has available $1,694,620 from the 1st, 2nd, 3rd, 4th, and 5th HCD program year funds for a combination of grants, rebates and interest-subsidized loans to small businesses in 12 City areas for rehabilitation purposes.

The interest subsidies are at 4% to merchants or owners of commercial properties on loans acquired through private financial institutions. Forty percent of the eligible merchants within a target area must petition for CARE certification.

HUD

2. Homeowners' Encouragement Loan Program or Hardship Emergency Loan Program (HELP)

This HCDBG financed program is specificially designed to provide financial aid to eligible property owners who do not have funds to correct code violations.

As presently set up, an owner must show financial need and there is a $10,000 limit on loans. Apartment owners are eligible, with four units or less, if there is financial need and if the property is rented to low income tenants.

These loans are interest free and are repayable over a ten year period. The program is administered by the Building and Safety Department with the United California Bank administering the loans at a cost to the City of $1.00 per loan per month.

Presently there is approximately $1.2 million in the HELP account. According to the General Manager of Building and Safety Department, the number of loans in process plus those anticipated will exceed available funds.

3) Multi-Family Opportunity Rehabilitation Effort (MORE)

This program is designed to provide low-interest rehabilitation loans to apartment building owners who agree to contract for Section 8 rental subsidies as well. This program has been in existence for several years, but not adequately used.

As of March 1979 the MORE program had an unencumbered balance of $2.8 million. Presently there is a program underway in Crenshaw which will use $816,000 of 3rd and 4th year MORE funds for stabilizing apartment buildings in that area. This particular project, called "The Apartment Improvement Program" will be done in cooperation with the National Neighborhood Investment Corporation (NRC).

Further information about NRC is provided in a later section.

NOTE: In the above three programs, CARE, HELP, and MORE the City can change criteria for loan availability within certain broad guidelines. These are local option programs, funded by the City's Block Grant and not administered by HUD.

HUD

## B. Section 312 Rehabilitation Loans

Other than the HCD Block Grant, the HUD representative at the Los Angeles Office, interprets the Section 312 Rehabilitation program as being their most applicable one for use in making buildings conform to the earthquake standards. According to the HUD spokesman, there should be sufficient funds available for Section 312 Rehabilitation Loans and the City has not taken advantage of the funds that have been allocated to this area.

The Section 312 Rehabilitation Loans, authorized under the Housing and Community Development Act of 1964, provide direct Federal loans to finance rehabilitation of residential, mixed use, and nonresidential properties. By financing rehabilitation to bring property up to code, the loans may prevent unnecessary demolition of basically sound structures.

Loans may not exceed $27,000 per dwelling unit or $50,000 for nonresidential properties. The applicant must be unable to secure financing from other sources on comparable terms and conditions. Preference is given to low and moderate income applicants but others are not precluded from making application.

## C. Section 221 (d)4 Multifamily Rental Housing for Low and Moderate Income Families

This HUD program provides mortgage insurance to finance construction or rehabilitation of multifamily (5 or more units) rental or cooperative housing for low and moderate income or displaced families. HUD may insure up to 90% of the total project cost. Mortgages are limited to profit-motivated sponsors. Tenant occupancy is not restricted by income limits, except in the case of tenants receiving subsidies.

## D. Section 202 - Nonprofit, Elderly/Handicapped Housing

This program provides long term, low interest loans directly to private, nonprofit sponsors to finance rental or cooperative housing facilities for elderly or handicapped persons. The interest rate is based on the average rate paid on Federal obligations during the previous year.

## E. Section 207, HUD Insured Mortgages

HUD insures mortgages by private lending institutions at market rates to finance construction or rehabilitation of multi-family rental housing by public and private developers. All projects must be located in an area approved by HUD for rental housing and in which market conditions show a need for such housing. There is no requirement that property owners be low or moderate income.

F. Lower-Income Rental Assistance (Section 8)

HUD provides rental assistance which may be used in existing housing or in new construction or for substantially rehabilitated units. Local public housing agencies administer the Section 8 existing housing program and contract with approved landlords for payment.

Private developers and nonprofit organizations, as well as public housing agencies submit proposals for substantial rehabilitation or new construction in response to invitations from HUD, or they may apply to their State housing finance agency. On approval of the proposals, HUD contracts to subsidize the units to be occupied by eligible families.

HUD makes up the difference between what a lower income houshold can afford and the fair market rent for an adequate housing unit. No eligible tenant need pay more than 25% of adjusted income toward rent. The subsidized units must meet HUD standards.

Following are further details about the Section 8 Rehabilitation Subsidy programs.

Section 8, Substantial Rehabilitation Rental Subsidy

This substantial rehabilitation subsidy applies to owners of multi-family units who undergo extensive rehabilitation measures. Occupancy must be by low income tenants with large families in areas with a low vacancy rate in rental housing.

According to the area HUD office, it is not certain that there will be a local "set aside" for Section 8 rehabilitation funds because there have not been sufficient responses to their previously issued requests for proposals. If additional funds are allocated to this area, a new request for proposal may be issued in October, but it does not look encouraging.

At the present time $3 million in Section 8 Rehabilitation and new construction rental subsidies for property owners in a section of Hollywood has been made available. Rehabilitation of existing housing or construction of new multi-family housing qualify for the Section 8 rental subsidies. This program is being administered by the Community Development Department.

Section 8, Moderate Rehabilitation Subsidy

This program is also designed to provide incentives for rehabilitation of multi-family units by offering subsidies to owners who rehabilitate units for occupancy by low income tenants with large families in areas with low vacancy rates.

These funds are restricted to those units requiring only $2,000 to $5,000 worth of rehabilitation per unit. According to a HUD representative, the deadline for requests for proposals for this funding cycle was July 1979. No proposals had been submitted by that date.

## HUD

### G. Mortgage Insurance for Hospitals, Nursing Homes, Intermediate Care Facilities

HUD provides mortgage insurance on loans by private lenders for construction or rehabilitation of hospitals, nursing homes, and intermediate care facilities.

### H. Urban Development Action Grant (UDAG)

The UDAG program provides assistance to stimulate new, increased private investment for revitalization of local economies and reclamation of deteriorating neighborhoods. Although UDAG's priority is on commercial and industrial projects, funds may also be used to support rehabilitation projects in residential neighborhoods having excessive housing abandonment or deterioration.

HUD will take into consideration "unique physical distress factors" particularly relevant to the applicant's jurisdiction. Eligible activities are broadly defined and may include direct grants for rehabilitation as well as equity funding, loans, loan guarantees or other appropriate mechanisms for joint public/private development.

A UDAG project would require a one to six ratio to public to private dollar commitment. One possible approach would be to use HCD Block Grant funds for interest subsidies on rehabilitation loans from private lending institutions and additionally apply for UDAG interest subsidies to further reduce the interest on such loans.

The disadvantage of using UDAG grants and loans for the earthquake ordinance rehabilitation purposes is that a project would involve a relatively small, localized area. A representative of HUD has stated that, although UDAG is appropriate relative to its purposes, in actual fact there would be problems in carrying out a UDAG project in a specified area when there would be spot rehabilitation of affected buildings in the midst of non-affected buildings.

### I. Special HUD Programs

HUD normally funds a limited number of projects each year under an "Innovative Grants" category which must relate to housing. This year a priority emphasis was given to problems relating to displacement.

This type of demonstration project would fund rehabilitation of an earthquake-unsafe building to provide housing for persons displaced because of the ordinance.

In addition, HUD has previously funded a City project which combines workers trained under the Comprehensive Employment and Training Act (CETA), and an agreement with the local building trades to perform the work at 75% of the current wage scale.

HUD

Unsolicited Proposals

HUD's Office of Policy Development and Research has procedures for accepting unsolicited proposals at any time which relate to HUD's overall program purposes.

) U.S. Depatment of Health, Education and Welfare

A. Medical Facilities Construction Project Grants

This program provides grants to states, local governments, or other health jurisdictions for modernization designed to eliminate safety hazards in publicly owned or operated health facilities.

3) U. S. Department of Commerce
Economic Development Administration (EDA)

Under the Public Works and Economic Development Act of 1965, as amended, Title II provides direct loans and loan guarantees to commercial and industrial businesses for working capital, equipment and improvements. This includes renovation of existing facilities and construction of new projects. Federal participation may not exceed 65% of the project cost and such businesses must be located in a depressed area. EDA regulations also require that one job must be created or saved for each $10,000 spent under this program.

Under pending legislation in Washington which, if enacted, would replace the Public Works and Economic Development Act of 1965, grants for up to 100% of eligible costs would be authorized for certain projects. In addition, projects for environmental impact reports could receive up to 100% of their costs. Bonus grants for up to 10%, subject to the 80% limit on Federal participation, would be authorized for projects within redevelopment areas within economic development districts.

4) Small Business Administration (SBA)

A. Section 502 Program

According to the guidelines, the Section 502 program is a source of loan money to local development corporations (LDC's) for plant remodeling and expansion. Thus, the loans for remodeling or rehabilitation appear to be a potential source of financial assistance for owners of earthquake hazardous buildings.

The City Office of Economic Development has made extensive use of the Section 502 loan program through its cooperation with the National Development Council in the City's Neighborhood Business Revitalization Program. To date the Office of Economic Development has assisted in pr[illegible] approximately $39 million in loans of which [illegible]ed. The majority of [illegible]

SBA

B. Section 7(a) Program

One element of this SBA program provides loan guarantees enabling private banks to make loans to small businessmen for renovation or new construction projects. SBA will guarantee loans up to $350,000 and will provide direct loans up to $150,000.

Predisaster Loans

Following the 1971 San Fernando Valley earthquake, low interest loans (6%, with a forgiveness clause of $2,400) were provided by the SBA to affected owners. The SBA in Washington has advised that there is little likelihood of SBA's undertaking a loan program geared to pre-disaster conditions which would assist owners of earthquake-hazardous buildings to comply with the proposed ordinance. The problem relates to the needs of other sections of the country in the event of hurricanes, floods, etc.

5) Internal Revenue Service

Tax Reform Act of 1976, as amended

Tax Credit for Commercial Buildings

A 10% investment tax credit (i.e., a credit applied after taxes are computed) is available for qualifying rehabilitation expenditures on commercial buildings that have been in use for at least 20 years prior to rehabilitation. All commercial buildings except those, such as apartments, which are used for residential purposes are eligible. Such expenditures must be a "qualified rehabilitation expenditure" incurred after October 31, 1978 for improvements with a useful life of five or more years.

According to the January 1979 Journal of Taxation, "...qualifying rehabilitation expenditures are broadly defined to include replacement of plumbing, electrical wiring, flooring, permanent interior partitions and walls, and heating or air conditioning systems. Additionally, expenditures such as the removal of existing interior walls or flooring will qualify if incurred in connection with the rehabilitation of a building..."

Costs for acquiring or completing a building or for the replacement or enlargement of a building do not qualify. If more than 25% of the exterior walls are replaced, the rehabilitation does not qualify for the credit.

Residential Rental Property

Also, under the Tax Reform Act, there is a "five year rapid write-off" available to owners of residential rental property housing low-income tenants. This tax deduction, which has the effect of reducing the income on which the tax base is computed, is available to owners of residential rental property housing low-income tenants. Such rehabilitation expenditures must be made prior to January 1, 1982, unless the law is extended by Congress. Rehabilitation expenditures must be greater than $3,000 per dwelling unit over a period of two consecutive years, but may not exceed $20,000 through December of 1981. Taxpayers may compute their depreciation deduction by using the straight line method, a useful life of 60 months (5 years), and no salvage value, in lieu of any other method of computation. No deduction of depreciation may be allowed with respect to the rehabilitated property under any other provision of the Tax Code.

6. National Neighborhood Investment Corporation

The National Neighborhood Investment Corporation (NRC) receives Congressional appropriations to operate apartment improvement programs. The NRC provides small grants and technical assistance to cities to stabilize large apartment buildings in early stages of decline in low and moderate income neighborhoods; they are also concerned with code requirements.

The NRC program involves a partnership effort with property owners, tenants, financial institutions, and the City, as the coordinator of the activity. The City is presently in the process of final approval of an agreement with the NRC to undertake an apartment improvement program in the Crenshaw area of the City.

7. National Development Council (NDC)

The NDC is a private nonprofit organization, under contract to HUD, the Small Business Administration (SBA), and the Economic Development Administration (EDA) to coordinate an inter-agency program for industrial and commercial revitalization in selected target cities by creation of Local Development Corporations (LDC's).

The City of Los Angeles has established an LDC, operating as the Economic Development Corporation, and administered through the City Office of Economic Development.

8. Urban Reinvestment Task Force

The Urban Reinvestment Task Force is a public/private coalition, authorized under Title V of the Housing and Urban Development Act of 1970, to stimulate and aid investment in inner city revitalization.

The Task Force supports two programs: Neighborhood Housing Services and Neighborhood Preservation Projects. The major role of the Task Force is that of catalyst, bringing together members of local partnerships. A high risk revolving loan fund is established which is developed and administered through a partnership of local residents, financial institutions, and local government.

A project developed under this program must have a specific neighborhood boundary which is one disadvantage relative to the earthquake ordinance.

## STATE

1) Department of Housing and Community Development

Chapter 884 (Statutes of 1978) authorizes the State Department of Housing and Community Development to provide housing rehabilitation loans at low interest, with deferred payment. A maximum of $2 million a year may be used for this program.

Further, the legislation provides that local agencies may receive interest free loans for rehabilitation of a structure following the owner's failure to commence repair work after final notice from the local enforcement agency.

Housing Advisory Service (HAS)

Within the State Department of Housing and Community Development Chapter 1364, Statutes of 1978, has created a Housing Advisory Service (HAS). One of the purposes of HAS is to provide information and technical assistance to present and prospective self-help builders and rehabilitators.

Small grants, of up to $15,000, are being offered to local agencies to establish local HAS's. The scope of activities may include, but are not limited to the following:

- Providing information, advice and technical assistance regarding rehabilitation and construction financing, and
- Explaining building codes and standards, housing codes and permit processes.

This grant program appears to be one way in which the City could fund at least part of the cost of a service to provide information on rehabilitation financing sources to those persons who will be affected by the proposed ordinance.

We have been advised that such a project would be eligible for funding as long as the local HAS also provided information on self-help rehabilitation and construction for persons not affected by the ordinance. We have requested appropriate application forms for this purpose.

Economic Development-Public Works Grant Program

The State of California, through the Department of Housing and Community Development participates in a cooperative funding assistance program with the EDA, authorized under Title III, Sec. 304 of the Public Works and Economic Development Act of 1965, as amended. Through this program, grants can be made available to public and nonprofit agencies for projects which will result in the creation of new permanent jobs in the private sector.

Eligible activities include rehabilitation, alteration, expansion of facilities. Projects must directly or indirectly tend to improve opportunities for successful establishment or expansion of industrial or commercial plants or facilities or otherwise assist in the creation of additional long-term employment opportunities, or [illegible] benefit the long term unemployed and members [illegible]

### 2) State Department of Health Facilities Development Section

A mortgage loan insurance program for nonprofit organizations is available through the State Department of Health. Refinancing to provide rehabilitation funds is allowable if a substantial portion of the refinanced amount is to be used for construction improvements. This would be appropriate for the hospitals and nursing homes impacted by the proposed ordinance.

### 3) State Enabling Legislation

#### Marks-Foran Residential Rehabilitation Act of 1973 and SB99

The Marks-Foran Act authorizes cities, counties, housing authorities, and redevelopment agencies to issue tax exempt revenue bonds to finance residential rehabilitation.

SB99 allows redevelopment agencies to issue revenue bonds in order to provide long term, low interest loans to finance residential reconstruction in approved redevelopment areas.

Specifically, Marks-Foran loans may be used to pay for work needed for compliance with a City's residential rehabilitation standards (a maximum of $35,000 per unit or 80% of the anticipated after-rehabilitation value of the property); and general property improvements not required by the City's residential rehabilitation standards (up to 20% for absentee owner property and up to 40% for owner-occupied property.

Present interest rates on both SB99 and Marks-Foran loans are between 6 and 7%. All loans must be insured by the Federal Housing Administration or other qualified sources.

Pending Federal legislation, the Ullman Bill et al, has placed the viability of the Marks-Foran and SB99 approaches in a state of hiatus until Congress takes action on legislation limiting tax-exempt financing mechanisms. The feeling in Washington is that some type of legislation will pass the next session of Congress.

### 4) California Housing Finance Agency (CHFA)

The CHFA is a source of rehabilitation financing under its Neighborhood Preservation Programs. The agency operates a direct loan program for the substantial rehabilitation of rental housing (five or more units). Eligible recipients are nonprofit sponsors or limited profit developers. The tenants ultimately to be served must be primarily low income persons, including elderly and handicapped. CHFA also has available Section 8 "Set Asides."

On occasion, representatives of the CHFA have advised that the City of Los Angeles has not taken advantage of the housing opportunities available under CHFA programs. The Chairman of the Grants, Housing and Community Development Committee met recently with the Direct[illegible] CHFA to discuss this matter.

### Comprehensive State Low Interest Loans

The question of the feasibility of the State's issuing low interest loans for the purpose of meeting code requirements for earthquake safety has been raised. It appears that the only way that the State could undertake a comprehensive low interest loan program would be to obtain voter approval of a State Bond Issue. In order for this to pass, it would have to incorporate funds for all cities in the State. This does not appear to be feasible, given the Proposition 13 and Gann Initiative, and also because of the amount of money that would be required. The money required for this purpose in San Francisco greatly exceeds the needs of Los Angeles, for example.

## LOCAL

### 1) County

One of the major economic problems of rehabilitation is an almost immediate upward valuation by the County Assessor. According to statutory implementation of Proposition 13, the County Assessor can reassess property when it is improved but only for the value of the improvement, not for the overall value of the property. Hence a structure that is improved for earthquake conditions would be subject to reassessment only for the value of the improvement. There is no question, however, that such improvements would probably be substantial.

To exempt a new class of property from property tax would require a constitutional amendment.

Legislation could be introduced at the State level to permit a number of years during which there would be no re-evaluation, thereby providing an incentive.

### 2) Community Redevelopment Agency (CRA)

Money could be made available for construction of low and moderate income housing from the tax increments resulting from the Bunker Hill redevelopment. This money could be used, as an example, to convert a seismically unsafe building not presently designed for residential housing, to provide housing for those displaced by the passage of the earthquake ordinance.

The Council could allocate the money and concurrently authorize special consideration for those to be relocated as a result of the earthquake ordinance.

### 3) City of Los Angeles

With regards to the City's potential for insuring predisaster loans, the City Attorney has advised that the Council could reasonably conclude that expenditure of City funds for reconstruction and rehabilitation of unsafe buildings serves a public purpose. Therefore, a seismic safety project using the leverage of City funds would be legal.

## City Rent Control Ordinance

Under the City's present Rent Control Ordinance, a landlord is entitled to a monthly increase of 1/36th of the per-unit rehabilitation cost of rehabilitation work performed in compliance with an order issued by the City of Los Angeles Building and Safety or Fire Departments or by the County of Los Angeles Health Department. This means that the landlord divides the total rehabilitation cost by 36 and then divides the monthly increase equally among all units benefitting from the rehabilitation work.

In a case where the rehabilitation benefits some units, but not all, only those benefitting can be charged the additional rent.

Before a landlord may increase rent on the basis of a legally mandated rehabilitation cost, the landlord must first obtain the written approval of the City of Los Angeles. The landlord may obtain such written permission by applying to the Rent Stabilization Unit for evaluation and approval of any rent increase based on rehabilitation.

In the case of some low-income tenants, a rental increase based on substantial rehabilitation costs may exceed the capability of the tenant to pay. Because rehabilitation costs connected with the proposed earthquake standards ordinance may be excessive, your Committee may wish to consider amending the City's Rent Control Ordinance to provide a different formula upon which rents may be increased for low and moderate-income tenants in connection with rehabilitation mandated by the proposed Earthquake Ordinance.

## Municipal Finance Agency (MFA)

Council has given preliminary approval to steps leading to the creation of a Municipal Finance Agency which could issue tax exempt bonds without the need of a referendum. As presently designed, the initial program would issue $300 million bonds: $180 million for Rental Housing Program; $90 million for Newly Constructed Ownership Units; and $30 million for Condominium Conversion Program.

This concept could be expanded to include funds for loan to property owners to make rehabilitations necessary for compliance with the proposed earthquake ordinance.

The Municipal Finance Fund Task Force was directed to report back to Council by October 9, 1979, with specific recommendations for implementation of the program.

An advantage of an MFA is that it is not subject to the many regulations and restrictions imposed by the State on Marks-Foran and SB99 projects. The City could further subsidize the interest rates by using additional HCD Block Grant funds.

However, the operation of an MFA could be severely restricted by the passage of the Ullman Bill (HR3712) or similar legislation in Congress. The legislation which is in the forefront, "The Mortgage Bond Subsidy Act of 1979," is designed to direct the subsidy from the use of tax exempt bonds for housing to those individuals who have the greatest need and to restrict the overall revenue loss to the U.S. Treasury from the use of local government-issued tax exempt bonds.

An additional amendment is expected which will place a moratorium on issuance of tax exempt municipal bonds for two years while the issue is studied further. The bill is currently in the Rules Committee and is not set for hearing at this time.

Council approved a City position to seek amendments to HR3712 (Ullman) including the exemption of housing activity, as defined by local government, to meet urgent public needs (e.g., to bring housing up to Seismic Housing Safety standards) or in cases where traditional mortgage financing becomes unavailable.

Alternative Approach - City Tax Exempt Financing

There is another approach which could provide tax exempt financing for targeted community development rehabilitation. This approach would be for the City to use Community Development or other public funds to "leverage" private funds. One type of leveraging technique could be executed through a tax exempt revolving loan arrangement whereby the bank makes a loan to the City which in turn relends to eligible property owners. The lower rate to the property owner is provided by the tax exempt benefits and additional agency reserve funds. These reserves are used both to lower the rate to the agency, and ultimately the property owner, and to guarantee against default.

If the Municipal Finance Agency were in existence, this type of approach could be used with the MFA as the administering agency.

Direct borrowing from local financial institutions for community development purposes has been used by Portland, Oregon, Denver, Colorado, and other cities.

It is not clear at this point if this approach would be subject to the restrictions of the Ullman Bill. Further legal clarification is needed.

The financial institution participates with the expectation of normal profits and also to satisfy community service obligations, especially those specifically enforced under the Community Reinvestment Act. (The Community Reinvestment Act, Title VIII of the Community Development Act of 1977, requires each Federal financial supervisory agency to use its authority, when examining financial institutions, to encourage such institutions to help meet credit needs of the local communities in which they are chartered, consistent with the safe and sound operation of such institutions. )

The loans are usually secured by Title I Home Improvement Insurance and/or reserves set aside with HCD Block Grant funds. (As part of the 1978 amendments to the Housing and Community Development Act, Congress directed HUD to permit lump sum drawdowns of Block Grant funds to be used in such guarantee reserves or other arrangements which promote the leveraging of local private funds for community development rehabilitation programs.

The Los Angeles Community Redevelopment Agency (CRA) is presently doing a study on the feasibility of this and other leveraging programs that may be implemented in cooperation with private institutions, using public funds.

### 4) Local Financial Institutions - Private Financing

The basic method, where possible, for funding rehabilitation projects is through private financing. It is obvious that some owners of commerical and industrial properties may be able to obtain rehabilitation loans with comparative ease. The City's concern is primarily with those affected property owners who would have difficulty obtaining a loan, the cost of which would make operation of the affected business unprofitable, and also for tenants who might be affected adversely either in rent increases or in having to be displaced because of rehabilitation measures.

It was pointed out in one of the reports of the Seismic Safety Commission (October 1977- Schmid) that the "... present cash flow to the owner of specific apartment houses reviewed is in the amount of 15 to 20% for those buildings of unreinforced masonry bearing walls built prior to 1933. This compares with a cash flow of 6 to 8% to an owner of a wood frame and stucco apartment building built in 1965. It seems that many owners could sustain the cost of strengthening and refurbishing these older units if the private sector can be encouraged to provide long term loans at prevailing new construction rates for the necessary improvements. One specific building owner has stated that lending institutions have a current practice of refusing to lend money on a building more than 40 years of age..."

In general, banks can be helpful in either guaranteeing the purchase of tax exempt bonds that would provide funds for rehabilitation loans; making below-market interest rate rehabilitation loans based upon a City's HCD Loan Block Grant entitlement; making flexible modernization loans directly to users under a structured program. A high risk revolving loan fund for non-bankable loans is often a necessary ingredient of these programs, particuarly when there is a mandatory code enforcement requirement.

Following are responses obtained from the Security Pacific Bank and Bank of America relative to their desire to cooperate with the City in the financial requirements that will result from enactment of the earthquake mitigation ordinance.

### Security Pacific Bank

A letter to the Building and Safety Committee is attached from Security Pacific Bank indicating that they are very interested in working with the City to use a full spectrum of their credit programs for the purposes of implementing the earthquake ordinance. They are prepared to cooperate with and work with the City in whatever ways will be most helpful.

### Bank of America

The Bank of America had participated in the 1977 Seismic Safety Commission's Workshop on Hazardous Buildings. At that time the Bank of America indicated that they are committed to a program of providing financing opportunities which would be helpful to citizens and cities in rehabilitation efforts.

Mr. K.S. Smeby, Senior Vice President, Administration, of the Bank of America stated this week that the Bank is interested in implementing programs of assistance relative to earthquake rehabilitation and is desirous of working with the City of Los Angeles.

Mr. Smeby indicated to a member of my staff that he has made several attempts to reach an agreement with the City's Housing Coordinator on community improvement and rehabilitation programs but has been unsuccessful to date.